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ELECTRONICS AND ELECTRICAL ENGINEERING

No. 74

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16. Abstract (Limit: 200 words)

The report contains articles, abstracts and news items on electronic materials, components, and devices, on circuit theory, pulse techniques, electromagnetic wave propagation, radar, quantum electronic theory, development and devices, miniaturization techniques on electric power machinery, power transmission, and nuclear power developments.

USSR REPORT

Electronics and Electrical Engineering

No. 74

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POWER METAL-INSULATOR-SEMICONDUCTOR TRANSISTORS IN SONIC AND ULTRASONIC FREQUENCY AMPLIFIERS

BACHURIN, V. V. and D'YAKONOV, V. P.

[Abstract] Ordinarily, the amplifiers of sonic and ultrasonic frequencies widely used in radio engineering are made with bipolar transistors. However, the latter have a number of shortcomings. Power field-effect transistors (with a controlled p-n junction and with a MIS structure) eliminate the majority of these shortcomings. This furnishes good prospects for construction of sonic and ultrasonic frequency power amplifiers on their base. The characteristics of power MIS transistors developed in the USSR are shown in a table, and examples of the use of such transistors in the construction of push-pull circuits with nontransformer load connection are presented. It is shown that series produced MIS transistors can be used in sonic and ultrasonic frequency power amplifiers with small dynamic and nonlinear distortions and increased operational reliability. The output power and efficiency can be increased because of the parallel connection of power MIS transistors without especial measures with respect to balancing of the currents flowing through them. The small switching time makes promising the construction of power amplifiers based on power MIS transistors, operating in a switching mode (class D). The authors thank N. A. Sivolov for assistance in measuring the characteristics of circuits. Figures 4; tables 1; references: 6 Russian.
[30-6415]

ANTENNAS

A METHOD OF CALCULATING INHOMOGENEITIES WITH A SMALL SCATTERING CROSS SECTION IN THE
FIELD OF A PLANE WAVE

YEROKHIN, G. A. and RYVLINA, A. A.

[Abstract] The perturbing effect of an inhomogeneity in an electromagnetic field is
reduced through the appropriate choice of the shape of the object and the boundary
conditions at the surface. This makes it possible substantially to reduce the rate
of change of the impedance function, which leads to a widening of the working band-
width. The shape of the inhomogeneity is determined as a result of solving the in-
verse diffraction problem, by finding the lines of the real component of the complex
Poynting vector. The conditions are found for which the profile and boundary con-
ditions of the synthesized inhomogeneity vary smoothly over the length, thus provid-
ing for stable operation in the working frequency band. An inhomogeneity is pro-
posed and synthesized, and then studied experimentally; its dimensions were 147.2
mm long with a diameter of 54.4 mm at a wavelength of 32 mm. The object was placed
in front of a horn aperture producing a wave close to a plane wave. The directional
pattern of the entire system was measured in order to compare the pattern of the
horn, both alone and in the presence of a metal cylinder of the given diameter. It
is shown that the synthesized inhomogeneity, which has a complex shape, introduces
extremely small distortions in the directional pattern of the horn. Similar results
are also found at frequencies above 500 MHz. The proposed synthesis technique used
for controlling the integral scattering characteristic can also be extended to in-
homogeneities having the requisites differential characteristics, for example, with
certain necessary back or forward scattering cross-sections. The author thanks V.
G. Gofman for assistance in conducting the experiment. Figures 3; references 6:
5 Russian, 1 Western.
[314-8225]

ANTENNA SYNTHESIS USING A MODIFIED PARTIAL DIRECTIONAL PATTERN PROCEDURE

KOMAROV, M. Yu., KRITSKIY, S. V. and NOVOSARTOV, M. T.

[Abstract] The method of anten.. synthesis using partial directional patterns is based on the expansion of a specified directional pattern in a series of functions forming an orthogonal system, and has a simple solution when limited to a series with a finite sum. The unacceptable error which arises is circumvented by the modified procedure of partial patterns proposed in this paper. The pattern being synthesized is represented in the form of a sum of two functions, each of which can be expanded in an orthogonal system of partial patterns so that the roots of the functions of one orthogonal system fall between the roots of the functions of the other. Analytical expressions are derived and used to compute the current distribution along a linear source 7.5 wavelengths long for two different and complex directional patterns. The results of the current distribution and the sidelobe suppression are shown graphically; it is argued that the modified procedure allows for the synthesis of a broad class of antennas with feasible current distributions. Figures 5; references 3: 2 Russian, 1 Western.
[314-8225]

USING AN INTEGRAL EQUATION METHOD TO STUDY ANTENNAS PLACED NEAR AN INTERFACE BETWEEN TWO MEDIA

BASHKOVSKIY, S. L., Institute of Radio Physics and Electronics, UkSSR Academy of Sciences

[Abstract] An integral equation method is proposed for determining the distribution of current in an antenna made up of a set of thin conductors of arbitrary configuration with consideration of reflections from a nearby interface. The integral equation of the antenna is converted to a system of algebraic equations, which is then numerically solved by computer. The complexity of systems that can be studied with this technique is limited only by the computer memory capacity. The M-222 computer can be used to analyze systems containing up to 60 elements with different currents. This corresponds to a total length of 5λ for the conductors making up to the antenna. The described technique is illustrated by application to a simple vertical

doublet and to a vertical dipole with asymmetric feed. Calculations are now in progress for a number of antennas close to an interface, and the results will be published in a subsequent report. The author thanks L. G. Sodin for constructive criticism. Figures 6; table 1; references 10: 1 Russian, 9 Western (1 in translation).
[312-6610]

INFLUENCE OF AN OBSTACLE ON COUPLING OF GROUND-BASED APERTURE ANTENNAS

BODROV, V. V. and ZAICHKIN, D. I., Moscow Power Engineering Institute

[Abstract]   The paper is a generalization of two earlier articles by these authors [see IZV. VUZ: Radiofizika, Vol 20, No 8, 1977, p 1201; Vol 22, No 10, 1979, p 1205] in which coupling between aperture antennas was considered above level ground, and the Green's function was found for the problem of diffraction of a spherical wave by an extended smooth cylindrical obstacle on the ground between the antennas. The barrier considered in the analysis is an infinite impedance cylinder with circular cross section. The radius of curvature and the height are taken as much greater than a wavelength, and much shorter than the transmission path. The quantitative characteristic of coupling is the power propagation ratio. An algorithm is derived for this coefficient, and a computer program is proposed for realization of this algorithm in ALGOL. Numerical calculations show that when the transmission path is long and the height of the obstacle does not exceed the altitudes of the antennas, there is a screening effect that is independent of the material or curvature of the cross section of the obstacle. This shielding action can be described by Fresnel integrals. The authors thank G. T. Markov for constructive criticism during the course of the work, and for taking part in discussions. Figures 4; references 10: 9 Russian, 1 Western.
[312-6610]

FLAT RADIO-OPTICAL ANTENNA ARRAYS WITH REJECTION OF INTERFERENCE SIGNALS IN THE DIRECTION OF ARRIVAL

GRINEV, A. Yu., VORONIN, Ye. N. and TIMCHENKO, V. S., Moscow Aviation Institute

[Abstract] A spectral method is proposed for synthesizing radio-optical antenna arrays that shape a fan of directional patterns that are minimized in the directions toward sources of interference (with ideally zero beam troughs). Radio-optical antenna arrays are based on the use of methods of coherent optics for shaping directional patterns. The proposed method of shaping controlled troughs in the beam fan does not interfere with the mode of parallel scanning, and can be implemented by optical hardware. An analysis is made of the structure of the processor, and relations are derived that can be used as a basis for designing optical processors of radio-optical antenna arrays with rejection of interference signals in the direction of arrival. Figures 7; references 11: 9 Russian, 2 Western (1 in translation). [312-6610]

5

RECEPTACLES FOR INSPECTION AND TESTING OF HYBRID CIRCUITS

SUDAKOV, A. I., engineer

[Abstract] Use of a computer in inspection and testing of hybrid microcircuits in batch and mass production enterprises requires holding fixtures adaptable to various different chips. Two such fixtures invented in the United States (patent numbers 3,409,861 and 3,912,983) require different special connectors for hybrid circuits with different numbers of output leads, and they incorporate flat springs which can bend or otherwise deform so as to break the contact with chip leads. An adaptable fixture free of these drawbacks has been developed at the Yaroslavl Design Technological and Scientific-Research Institute for hybrid circuits with beam leads. It consists of a base plate with a pin plug and a row of printed-circuit contact washers across grooves in a frame into which all output leads of a tested hybrid circuit can also be appropriately inserted. Reliable contact with a uniform pressure is ensured by elastic studs with oblique faces on the inside of the lid, one stud for each contact washer. A window in the lid improves the temperature distribution during tests with the lid closed. An experimental inspection of 50,000 hybrid circuits in a batch indicates that this improvement alone can save 20,000 rubles on a lot of this size. Figure 1; references: 2 Western.
[27-2415]

CERTAIN ASPECTS OF PHOTOGRAPHY,
MOTION PICTURES AND TELEVISION

FIXING OF STANDARDS AND MEASURING OF FLUCTUATION INTERFERENCE IN TELEVISION
TRANSMITTERS

GEL'FAND, V. M.

[Abstract] Standards are proposed with respect to the levels of fluctuation and
periodic interference in television transmitters. The following items are discussed:
1) Fixing of standards of fluctuation interference (FI); 2) Measurement of FI in
transmitters; and 3) Measuring and fixing of standards of periodic interference. It
is shown that with a uniform FI spectrum at the input of the video channel of a TV
transmitter and a measuring demodulator at its output, the amplitude-frequency char-
acteristic has a decrease in the frequency region from 0 to f_1 which it is necessary
to take into account during evaluation of weighted FI. It is reasonable to perform
measuring and fixing of standards of the FI in the video channel of the TV transmit-
ter with the aid of a unified weighted filter, which agrees with the recommendations
of international organizations on the transmission channels of black-white and color
television. In a TV transmitter with intermediate frequency modulation, it is ad-
visable to measure the periodic interference only in the case where the FI level
does not conform to the standard. The author is grateful to M. I. Krivosheyev, G.
V. Babuk and A. M. Lokshin for valuable suggestions and critical comments expressed
during preparation of the manuscript of this paper. Figures 6; tables 2; references
9:   8 Russian, 1 Western.
[30-6415]

RECORDING OF VIDEO SIGNALS WITH AN 'ELEKTRONIKA L1-08' VIDEOMAGNETOPHONE

PERETYAGIN, I. V. and PORONIK, B. I.

[Abstract] An "Elektronika L1-08" videomagnetophone records television images by
the slanted-line interlaced-field method with one rotating head and plays them back
with two rotating heads. Full-frame recording, without interlacing, also requires
two rotating heads. For this purpose the velocity of the video tape must be made
twice as high by means of an adapter disk mounted on the drive shaft, and the pres-
sure of the video tape against the drive shaft must be increased by raising the
solenoid voltage from 12 to 18 V. Furthermore, the circuit which holds the second
head during recording must be disconnected. An additional plug makes it possible
to connect an automatic tracking device for checking the operation of the automatic
control system by an oscillograph. The latter system includes a matching and syn-
chronizing set which consists of a quartz-stabilized 500 kHz generator of synchro-
nizing pulses, a 1:16-1:625 frequency divider, and a pulse shaper. Its output
pulses with a 50 Hz repetition rate have an amplitude of 0.25-0.3 V and a duration
of $\sim$500 microsecond for precise measurement of the time parameters of recording sig-
nals. They can also be obtained from a multivibrator with stabilization from the
50 Hz network. The systems is tuned by the proper selection of resistors and ca-
pacitors. With certain modifications it can also record images from a television
camera not equipped with a synchronizing generator. This requires a JK trigger
and a monovibrator. The television receiver is plugged to the Y-input of the oscil-
lograph. Figure 1; references: 2 Russian.
[21-2415]

A SIMULATION MODEL OF CURRENT PLANNING FOR TV PRODUCTIONS

VORONOV, M. V., GORIZONTOV, A. M., KONDRAT'YEV, A. G., LISOGURSKIY, V. I., LUKIN,
M. I., MALESHKO, V. N. and MILEN'KIY, G. V., Leningrad Electrical Engineering Insti-
tute imeni V. D. Bonch-Bruyevich

[Abstract] A method is proposed for modeling the process of periodic scheduling of
the work load on studios and equipment of television broadcasting centers for prepa-
ration of TV transmissions, getting them on the air, preventive maintenance, repair
of equipment and other jobs. The analysis is based on the critical-path method.
A flowchart is given for the algorithm of automated current planning. The proposed
model is universal and can be applied to TV complexes with any hardware configura-
tion and different broadcasting volumes. Figures 4; references: 1 Russian.
[313-6610]

TV CHANNEL NETWORK OF THE OLYMPIC TELEVISION AND RADIO COMPLEX

PALITSKIY, V. M.

[Abstract] Video signals at the Olympic Games in Moscow are handled by a network
of 71 wide-band radio relay communications channels. A simplified diagram is given
of a typical channel, and operation is explained. The transmission paths of the
relay lines range from 2.4 km to 23 km depending on the athletic event being covered.
The reception antennas of the relay lines are on the roof of the 14-story Olympic
Commutation Center in Ostankino. The parameters of the channels meet all CCIR re-
quirements. Figures 1; tables 2.
[313-6610]

THE EFFECT OF NOISE ON LINEAR RULES FOR CHROMINANCE CLASSIFICATION

POPECHITELEV, Ye. P.

[Abstract] Of the algorithms for the automatic classification of the coloration of
the components of a color image, the most convenient are linear rules which can be
written in the form of a simple sum of chrominance coordinates in the colorimetric
system and the parameters of the linear rule resolver; this sum is either less than
or greater than zero, depending on the equation defining the separation boundary
between chrominance classes. The quality of automated color classification devices
depends on the precision in the conversion of the light flux to color coordinates
and the level of the noise in these values, as well as the accuracy in computing
the above sum and finding its sign. Since the majority of these errors are of a
statistical nature, the sign of the sum can vary and the separation boundary between
color classes is washed out. A procedure is proposed for the calculation of the
dimensions of the noise fluctuation regions, i.e., the extent to which the boundaries
are obscured in a color determination. The results obtained are of direct interest
in the estimation of additional chrominance classification errors caused by fluctua-
tions in the color coordinates, as well as for the estimation of the resolution of
automated color image analyzers. The proposed technique for calculating the regions
of indeterminacy can be used in the study of other sources of errors in other types
of light flux to color coordinate converters. Figures 2; table 1; references: 6
Russian.
[314-8225]

CERTAIN ASPECTS OF RADIOASTRONOMY, SATELLITES AND SPACE VEHICLES

ON THE QUESTION OF THE OPTICAL MODELING OF RADIOTELESCOPE ANTENNAS

MOROZOVA, I. A., Main Astronomical Observatory of the USSR Academy of Sciences

[Abstract] An experimental configuration is proposed for the optical modeling of the directional pattern of radiotelescopes, which uses a source of incoherent light, with partial spatial coherency. The light source is a flat face neon lamp with a diameter of 2 mm followed by a light filter made of "KS" glass which segregates a spectral range of 6,400 ± 100 Å. An objective follows the filter which produces an image of the end face of the lamp on a screen with a diaphragm. The diaphragm is a circular hole with smooth edges and a diameter of 0.143 mm in a layer of collodion. This is the source for a second lens and diaphragm combination at a distance of 1,930 mm from the first diaphragm. The spacing of the source from the lens provides for magnification of the image at a distance of 15,630 mm by a factor of 8.1 X. This magnification yields a large scale diffraction pattern with a primary maximum of 3 mm and more. The image is photographed in the plane at a distance of 17,516 mm from the first diaphragm. One mm on the film corresponds to an angle of 13.2". Shown as examples are photos of the diffraction patterns from an in-phase straight slot 2.01 mm wide for exposures of 27 minutes and 3 seconds. A comparison of the intensity distribution of the pattern from the straight slot when illuminated with the quasi-monochromatic incoherent source with the calculated values shows good agreement with the results of coherent modeling using a laser. Accounting for the incoherent nature of space emissions in optical modeling opens up new possibilities for the study of the directional patterns of radiotelescopes under actual observational conditions and consequently for improving the quality of the restoration of the true image from the observed one. Figures 3; references 4: 3 Russian, 1 Western.
[5-8225]

CIRCUIT THEORY AND PRACTICE

THE SYNTHESIS OF EQUIVALENT CIRCUITS FOR ELECTROMAGNETIC SHIELDS

KUZNETSOV, V. V. and LYUBOMUDROV, A. A.

[Abstract] While previous papers have found the equivalent circuits of shields with concentrated parameters at low frequencies where absorption in the shell can be neglected, this paper determines the equivalent circuits for shields with concentrated parameters throughout the entire range of frequencies which satisfy the quasi-steady-state condition, taking into account the absorption caused by eddy currents and the associated thermal losses. The absorption in the shield is accounted for by introducing a model of a long line with a known propagation constant and characteristic impedance. The equivalent circuit of the long line is shown and the case of practical interest where such an equivalent circuit has a small number of sections is analyzed. The transfer functions of the shield for the E and H fields found in previous literature are used with the hyperbolic functions which are represented by a power series. Expressions are derived for the frequency and phase characteristics of the shield and the precision in the power series approximation of the components of the equivalent circuit is estimated. A simple analytical equation is given for this approximation error. Figures 3; references: 3 Russian.
[314-8225]

A PHASE-LOCKED LOOP WITH A MICROPROCESSOR

MOVSHOVICH, A. M.

[Abstract] A phase-locked loop (PLL) consists of a phase detector driving a microprocessor which in turn drives a tunable oscillator and the oscillator also feeds its output to a frequency divider feeding back to the phase detector. This configuration is analyzed in order to determine some of the indicators for a PLL with a microprocessor, assuming that the microprocessor is the only discrete element in the

system. The transfer function is found for the microprocessor for which the lock-
on time is minimal, and an algorithm for the operation of the microprocessor is pro-
posed, for which this time is twice the processor switching period. The amplitude
of the interference noise at the output of the PLL caused by parasitic frequency
modulation of the input signal is also calculated and the frequency response of the
PLL is found for best and worst case conditions. Figures 4; references: 3 Russian.
[314-8225]

AN APPROXIMATION METHOD FOR STUDYING THE DYNAMICS OF SECOND ORDER PULSE-PHASE AUTO-
MATIC FREQUENCY CONTROL SYSTEMS

LEVCHENKO, G. M.

[Abstract] An astatic pulse-phase automatic frequency control (AFC) system is ana-
lyzed for the following circuit configuration: A pulsed signal is fed from the out-
put of a reference oscillator to a pulse-phase detector where it is compared with
the signal from a tunable oscillator and is then fed to the input of a pulse low-
pass filter (an equalized discrete integrator). The output signal of the low-pass
filter controls the frequency of the tunable oscillator. The transfer function of
the low-pass filter is specified and a sum and difference equation is written for
the pulse-phase AFC circuit. The subsequent analysis determines the capture band-
width of the system described by the equation. Computer studies of a mathematical
model of the system are used in order to ascertain system behavior for lock-on and
synchronization, and the results are presented graphically. The calculations of the
capture bandwidth are compared with those for a pulse-phase AFC system with an in-
tegrating filter based on a procedure found in the literature, as well as the one
proposed here. The deficiencies of the previous approaches are discussed and in con-
clusion it is briefly noted that the proposed technique can also be used to calcu-
late the duration of a transient process in such systems. The author thanks V. N.
Kuleshov for constant attention and assistance during fulfillment of the work. Fig-
ures 5; references: 8 Russian.
[314-8225]

SYNTHESIS OF A MULTIPHASE TRIGGER CIRCUIT TO BE USED IN A SENSOR-TYPE PROGRAM SELECTION UNIT

ANICHKOVA, N. S.

[Abstract] When a multiphase trigger circuit is used in a sensor-type program selection unit the input signals of the multiphase trigger circuit are the output signals of sensor-type transmitters and the output signals of the trigger circuit are at the same time the output signals of the sensor-type program selection unit. Both analog and computer techniques can be used to design multiphase trigger circuits. Multiphase trigger circuits of an analog design are critical in terms of precision in the fabrication of their elements and of instability of the power supply's voltage, and they do not have the advantages of semiconductor integrated circuits. A description is given of multiphase trigger circuits which are designed on the basis of computer hardware and are free of these disadvantages. A multiphase trigger circuit generally consists of a control unit and a storage unit, whereby the number of trigger circuit inputs determines the required number of steady states of storage unit memory elements. Here it is assumed that this number equals eight. The output of each of the eight memory elements is at the same time an output of the multiphase trigger circuit. Analytical expressions are obtained for the signals for exciting the storage elements by employing the so-called switching function, $Q_i^+(t) = Q_i(t + \Delta t)$, where $Q_i(t)$ is a real function of the output of the i-th memory element and Δt is the time of the delay in a change in the output signal in relation to changes in the input signal. A specific set of memory element switching functions corresponds to each set of output signals. From the value of switching function $Q_i^+(t)$ a definite determination is made of the required values of excitation signals in each of nine sets of input signals. The multiphase trigger circuit discussed is easily implemented on the basis of MIS (metal-insulator semiconductor) transistors. In one variant for each input of the multiphase trigger circuit there is a bistable cell, one of whose arms is in the form of an 8-exclusive-OR gate and the other of a 2-exclusive OR gate. Another variant makes it possible to form the eight states of the trigger circuit's output by using in the storage unit three memory elements and a decoder. In this variant the control unit and storage unit are realized by means of three bistable cells, where each arm of a bistable cell is a 5-exclusive-OR gate. The memory element state decoder is implemented by means of eight three-input exclusive OR gates. This results in a total minimum number of MIS transistors of 68. The first variant requires 96 transistors, but the second has a greater number of connections in the circuitry. By simplifying the first variant a third variant is found, which requires 80 MIS transistors for an eight-channel multiphase trigger circuit and at the same time satisfies the stipulation of a minimum number of connections in the circuit. The paper was recommended by the Department (Kafedra) of Micro Radio Electronics and the Technology of Radio Equipment, Leningrad Electrical Engineering Institute imeni V. I. Ul'yanov (Lenin). Figures 3; tables 2; reference: 1 Russian.
[14-8831]

COMMUNICATIONS, COMMUNICATION EQUIPMENT, RECEIVERS AND
TRANSMITTERS, NETWORKS, RADIO PHYSICS, DATA TRANSMISSION
AND PROCESSING, INFORMATION THEORY

CERENKOV RADIATION OF ACOUSTIC GRAVITATIONAL WAVES BY HORIZONTALLY MOVING SOURCES.
II.

LIPOVSKIY, V. D., Leningrad State University

[Abstract] The first article in this series treated the Cerenkov radiation of
acoustic gravitational waves (AGW) by a horizontally moving source in an unbounded
isothermal atmosphere [IZV. VUZ: RADIOFIZIKA, Vol 23, No 2, p 159], where it was
assumed that the path length was infinite. Because real objects are effective
sources of atmospheric perturbations over finite trajectories, this paper deals
with the specific case of a moving mass source with a finite path loss. The Ceren-
kov condition for the emission of such waves in anisotropic media, and consequently,
the limitations placed on the spectral emission ranges are expressed in terms of
the angles in space of the observation points. The intensity distribution is also
a function of the angle in the coordinate space and an explicit form is found at
first for the fields and distribution of the intensity for a point source moving
along an infinite trajectory. Then estimates are obtained which define the range
of applicability of these results to the problem of AGW emission by the source
traveling over a finite interval. The losses to coherent radiation by these waves
are also calculated. The behavior of the analytical expressions derived which de-
fine the Cerenkov conditions is discussed, though no specific numerical examples
are calculated. The author thanks V. N. Krasil'nikov for attention to the work.
References 9: 7 Russian, 2 Western.
[5-8225]

RANDOM SHIFTS OF THE IMAGE IN THE CASE OF OPTICAL DETECTION AND RANGING IN A TURBU-
LENT ATMOSPHERE

LUKIN, V. P., SAZANOVICH, V. M. and SLOBODYAN, S. M., Institute of Atmospheric Optics
of the Siberian Department of the USSR Academy of Sciences

[Abstract]   When the statistical characteristics of the fluctuations of optical
waves propagating in a turbulent medium are studied, it is necessary in a number of
instances to consider those waves reflected from mirror surfaces, thus passing
through the medium twice. This occurs during optical detection and ranging in the
atmosphere. The random shifts in the image of an optical source reflected from a
flat mirror, a 90° prism and a mirror-lens reflector are mathematically analyzed
and the results are tested experimentally. A collimated laser beam (wavelength of
0.63 micrometers) was transmitted over a 2 m path. The direct and reflected beams
were generated by two identical lasers and were adjusted so that the beams traveled
the same path. All of the beams, in passing through a convective turbulent medium,
were focused by a lens (focal length of 40 cm), in the focal plane of which the
random variations of the center of gravity of each of the images was studied. The
random shifts were recorded in two mutually perpendicular directions by a tracking
device with an image dissector. The dispersions were measured by a meter with a
dynamic range of not less than 40 dB. It was found that the random shifts of the
reflected images differed substantially from the case of direct beams. With reflec-
tion from a flat mirror, the angular fluctuations increase as compared to those of
the direct beam. A corner reflector corrects the random angular shifts while a 90°
prism corrects the random shifts in one of the directions. However, the effect of
autocompensation of the fluctuations in the wave reflected from a corner reflector
make this type unacceptable for purposes of atmospheric sounding, although such a
reflector is convenient from the viewpoint of aiming optical beams. It is noted
that over sufficiently long optical paths, a corner reflector will be equivalent
to a directional point reflector, and self-compensation of the fluctuations will
not occur. Figures 4; references 18: 14 Russian, 4 Western.
[5-8225]

THE RESULTS OF SIMULTANEOUS OBSERVATIONS OF GEOMAGNETIC VARIATIONS AND WAVE PERTURBA-
TIONS IN THE IONOSPHERE

AL'PEROVICH, L. S., DROBZHEV, V. I., KRASNOV, V. M., SOROKIN, V. M. and FEDOROVICH,
G. V., Ionosphere Section of the Kazakh SSR Academy of Sciences

[Abstract]   The propagation of internal acoustic gravitational waves leads to wave
perturbations of the electron concentration in the ionosphere.   This paper is a
test of the hypothesis that the changes in the electron concentrations with exposure
to such waves in the lower ionosphere should lead to variations in the geomagnetic
field.   The test is based on simultaneous observations of the spectral composition
of wave perturbations in the ionosphere and the variations in the H component of the
geomagnetic field, both under quiet conditions and during active periods occasioned
by powerful construction explosions.   The spectral composition of wave perturbations
in the ionosphere was studied by recording the doppler frequency shift for the case
of oblique (Tashkent to Alma-Ata) and vertical (Alma-Ata) soundings.   The oblique
frequency was 2.5 MHz, producing perturbations at altitudes of 75 to 85 km; the
vertical sounding frequency was 5 MHz (wave reflection altitudes of 200 to 250 km).
The precision of the doppler measurements was about 0.005 Hz for the oblique sounding
and 0.01 Hz for the vertical.   The changes in the H component were measured with a
precision crystal magnetograph with a precision of 0.5 gamma.   The calculation of
the power spectra showed that clearly pronounced spectral density peaks are noted
in the variations of the H-component of the geomagnetic field as well as the D and
F layers.   While the analysis of the background fluctuations in the doppler frequency
shift and the magnetic component as a function of time show good agreement with the
spectral composition of the fluctuations of the electron concentration in the iono-
sphere and the amplitude variations of the geomagnetic field, this experiment is not
sufficient for a final conclusion regarding a relationship between the phenomena
considered here.   In order to obtain more complete data and come to reliable con-
clusions, it is necessary to organize simultaneous studies at different points.   The
authors thank A. Ye. Levitin, IZMIRAN SSSR [Institute of Terrestial Magnetism, Iono-
sphere and Radio Wave Propagation, USSR Academy of Sciences], for magnitograms
courteously made available.   Figures 3; references 7: 5 Russian, 2 Western.
[5-8225]

A DEVICE FOR STROBOSCOPIC RECORDING OF WEAK SIGNALS AND THEIR EXTRACTION FROM NOISE

KATUSHONOK, B. S., KUDALENKIN, V. V., LIVSHITS, M. G., LISOVSKIY, N. L., SHESTAKOVA, L. I. and SHUSHKEVICH, S. S.

[Abstract] An instrument has been built for stroboscopic recording of weak periodic signals and their extraction from noncorrelated noise. It operates by the method of accumulation of discrete signal+noise mixture samples. It is designed for an electron-paramagnetic-resonance pulse spectrometer, but can also be used for tracking the response of a system to an external stimulus. A typical such application is measuring, with the aid of a high-speed photodiode and an argon laser, the luminescence relaxation characteristics. The instrument can be synchronized automatically or externally. Data in a digital code are stored in a semiconductor memory built with 507PU1 integrated microcircuits to a 16x1024 bits capacity. From here they are fed to a computer and, at the same time, converted to analog form for display on the screen of a cathode-ray oscillograph. The input signal can be scaled over a wide range and its d.c. component can be compensated. The instrument has a time resolving power of 10 ns and a sweep width ranging from 10 microsec to 10 ms. The total conversion error is 1%. The overall size is 580x500x240 mm^3. It operates from a 220 V - 50 Hz line drawing 55 W. Figures 2.
[21-2415]

ON THE RANDOM SHIFTS OF A DIFFRACTION IMAGE IN A TURBULENT ATMOSPHERE FOR A PATH WITH REFLECTION

BELOV, M. L. and ORLOV, V. M.

[Abstract] Previous papers have dealt with the fluctuations in the center of gravity of an image when a wave distorted by turbulence falls on a lens, as well as the image shifts at the focus of a telescope when finding a reflective disc and a corner reflector. Here the fluctuations of the center of gravity of a diffraction pattern produced by a receiving lens are considered where the wave beam is reflected from a plane surface with a random reflection factor. It is assumed that the source and the receiver are located in the same plane and their optical axes are oriented at different angles to the normal to the reflecting surface. The problem of finding the position of the center of image gravity is resolved by employing Green's function in a Fresnel approximation and using Huygens-Kirchoff's principle, generalized

for the case of continuously inhomogeneous media. An approximate analytical expression is derived for these fluctuations and it is noted that the results can also be useful in estimating the impact of atmospheric turbulence on the precision of the measurement of angular coordinates by optoelectronic transducers. Figures 2; references 9: 8 Russian, 1 Western.
[5-8225]

THE RELAXATION OF ANOMALOUS ABSORPTION OF A TEST RADIO WAVE

METELEV, S. A., Scientific-Research Radiophysics Institute

[Abstract] A probe radio wave with ordinary polarization experiences strong anomalous absorption (AA) at artificial inhomogeneities in the ionosphere when sounding a perturbed region in the F-layer. After the high power transmitter which perturbed the ionosphere is cut off, the inhomogeneities rapidly relax, and the level of the reflected sounding signal is restored to the value corresponding to an unperturbed ionosphere. Because inhomogeneities of different sizes have different relaxation times, the restoring phase of the AA of the test transmissions can contain information on the steady-state spectrum of the artificial turbulence in the interaction region of the test wave and the plasma. This paper derives analytical expressions in order to compute the differential contribution of such artificial inhomogeneities of different scales to AA (Z-mode transformation of waves with ordinary polarization). The relaxation process is assumed to be quasi-steady-state and the partial derivative with respect to time is neglected in the initial equation for the rate of transformation of radio wave to plasma wave energy at concentrated inhomogeneities. The question of the form of the steady-state spectrum of low frequency artificial turbulence is discussed in the light of specific experiments probing the F-layer in 1973 at frequencies of 5.723, 5.738 and 5.763 MHz. The amplitude of a test signal is plotted as a function of the transmit and pause times (3 minutes each). Two different classes of possible spectra are distinguished, the relaxation of which can produce the results experimentally obtained. The author expresses deep appreciation to L. M. Yerukhimov for formulation of the problem and constant attention to the work and to V. L. Frolov for permission to use his experimental data concerned with anomalous absorption. Figures 2; references 7: 5 Russian, 2 Western.
[5-8225]

THE ENGINEERING DESIGN OF A NOISE IMMUNE SYNCHRONOUS PHASE MODULATOR

KLEPITSA, N. A. and KHOROSHAVIN, A. I.

[Abstract] While the noise immunity of synchronous phase demodulators (SPD's) designed around phase-locked loops has been studied in the literature, it is necessary to reduce this information to simple expressions for engineering practice. This paper does so for the design of SPD's with second order loops for the cases of frequency and phase modulation. It is assumed that the models describing the transmitted messages are normal random steady-state processes, the interference is gaussian white noise with a zero mean value, the phase demodulator of the SPD (which is a nonlinear cosinusoidal element) is replaced by a statistically linearized element, and a proportional integrating filter with a specified transfer function is used as the low-pass filter in the loop. The equations for the design parameters of the SPD components are presented in tabular form and the following examples are treated. The parameters of an FM SPD for a specified spectrum are found for the case where the signal-to-noise power ratio at the demodulator output is either 200 or 23 dB while the bandwidth is 3.4 KHz. An FM demodulator is analyzed for the case of a message with a specified power spectrum density, where the modulating frequency is 0.3-3.4 KHz and the maximum deviation of the signal frequency is 20 KHz. Figures 1; tables 2; references 4: 3 Russian, 1 Western (in translation).
[314-8225]

THE DETECTION OF INCOHERENT RADIO SIGNALS AGAINST A BACKGROUND OF MARKOV INTERFERENCE WITH UNKNOWN PARAMETERS

VASIL'YEV, K. K. and KOMISSAROV, G. F.

[Abstract] Adaptive algorithms are widely used in detectors in order to assure a constant false alarm probability with a change in the distribution of the interference, where these algorithms employ a classified teaching sample in the interference range in addition to the readouts of the envelope of the random process in the signal range. This paper treats the case of post detector discrimination of signals against a background of Markov interference with unknown components of the normalized covariation matrix for the interference correlation. Algorithms are found for the detection of such incoherent signals and processing rules are synthesized and

analyzed which provide for a constant false alarm probability. The effectiveness
and stability of the algorithms derived was checked by modeling them on a computer
with the use of the Monte-Carlo method. The number of tests in the estimation of
the detection probability was 1,000, and there were 100,000 tests in the estimation
of the false alarm probability. The error probability was reduced to 10-15% in the
range of low false alarm probabilities and the detection characteristics for various
interference correlation coefficients were obtained as a result of the modeling.
Critical ranges for the detection rules are defined and graphically illustrated as
a function of the signal threshold for various values of the interference correlation
coefficients. Figures 2; references 5: 3 Russian, 2 Western.
[314-8225]

UDC 621.391.27

OPTIMAL COHERENT RECEPTION OF DIGITAL TRAFFIC UNDER CONDITIONS OF FLUCTUATING,
CONCENTRATED AND PULSED INTERFERENCE

SIKAREV, A. A. and SOCHNEV, A. M.

[Abstract] The impact of pulsed and concentrated interference on digital traffic
is analyzed by approximating the interference with a quasi-determinate random pro-
cess and utilizing the optimization principles from statistical communications theo-
ry. The analysis generates an optimal algorithm for the synthesis of a coherent
reception system. The interference approximation is based on the fact that such
interference is usually crosstalk from other transmitters and therefore has proper-
ties close to those of the useful signals, the quasi-determinate approximation of
which has a number of advantages. Pulse interference is essentially caused by re-
sponses of the channel ahead of the resolver circuitry to short, high power radio
pulses from storms and industrial facilities. This interference can be described
by functions containing one or more random parameters, but which are timewise con-
stant and depend on the power and time of occurrence of the perturbations at the
receiver input; such interference can thus also be approximated by quasi-determinate
random processes. The following assumptions are also made: fluctuating noise is
present as gaussian white noise of a specified spectral density; the transmission
factors of the interference pulse modulation frequency are measured and known pre-
cisely during reception; the fading of the concentrated interference is governed by
a Rayleigh distribution, quite characteristic of shortwave, ultra-short wave and
tropospheric links; the distribution of the initial phase is uniform over a full
cycle; the arrival time of the pulse interference is known within a precision of one
period of the RF signal response of the receiver channel ahead of the resolver. The
reception decision making algorithm is derived and two possible circuit configura-
tions are shown. A simplified algorithm is also given for binary systems with a

base two code and the noise immunity of systems is analytically determined for this case. The power advantage gained through the use of such an optimal algorithm for the case of the combined action of the above types of interference, with error probabilities of 10^3 - 10^4 and an arbitrary arrival time of the interference, amounts to more than 10 dB as compared to the algorithm optimal for noise alone. As compared to an algorithm optimal for channels with concentrated interference, this gain, depending on the time of pulse interference arrival, can range from 1 to 10 dB or more. The gain becomes even more substantial with an increase in the interference power. Figures 3; references 6: 5 Russian, 1 Western (in translation).
[314-8225]

AN ANALYSIS OF THE FINE STRUCTURE OF THE RESPONSE OF A FILTER WITH A SQUARE LAW PHASE-FREQUENCY CHARACTERISTIC FOR A LINEAR FREQUENCY MODULATED RADIO PULSE

POLYAKOV, P. F.

[Abstract] A linear frequency modulated (LFM) pulse with a rectangular waveform is applied to a dispersion filter (with a square law phase-frequency response). An analytical expression is derived for the complex amplitude of the filter response to this waveform, and the fine structure of the response is analyzed in order to produce equations for the amplitude in two cases: when the bandwidth is less than the frequency deviation, and when the bandwidth is greater. The behavior of the response is discussed for these two regions and shown graphically in the form of curves for the envelope and the response pulse modulation frequency, plotted as a function of the LFM pulse width. When the bandwidth is much less than the frequency deviation, the response does not show frequency modulation and its envelope is described by a simple hyperbolic trigonometric function of the bandwidth; when the bandwidth is much greater than the frequency deviation, the response shows linear FM, while the envelope is described by a similar function of the frequency deviation. The contradictions between some results in the literature and those of the author are resolved in favor of the latter. Figures 2; references 14: 13 Russian, 1 Western.
[314-8225]

AN ANALYSIS OF MARKOV MODELS OF DISCONTINUOUS RANDOM PROCESSES

KLOVSKIY, D. D. and KONTOROVICH, V. Ya.

[Abstract]   A Markov model of a discontinuous random process is described by a stochastic differential equation written in terms of an n-dimensional vector function which satisfies Lipshits' condition and an n-dimensional Poisson train of delta pulses with a specified repetition rate and amplitude probability density. Two procedures are proposed for analyzing such processes: A method of degenerate nuclei where the amplitude probability density of the pulse train is defined from zero to infinity and expanded in a series by means of orthogonal polynomials; the resulting expression is solved in order to obtain the steady-state probability density. The second technique is a "diffuse" approximation cumulative procedure where the solution is found by successive iterations. An estimate is derived for the correlation function of the discontinuous random process. The limitations on the applicability of the two techniques are discussed. References: 7 Russian.
[314-8225]

THE SPECTRAL CHARACTERISTICS OF THE NATURAL NOISE OF A TRANSISTOR DRIVEN WITH A LARGE HARMONIC SIGNAL

KULESHOV, V. N. and LESHUKOV, B. Ye., Moscow Power Engineering Institute

[Abstract]   Because bipolar transistors are widely used at frequencies where the inertia of their response must be taken into account, analysis of the noise characteristics of an inertialless model in the large signal mode is inadequate. An approach to the calculation of the spectral characteristics of transistor noise currents referenced to the input and output is proposed, based on a piecewise-linear approximation of the characteristics of a transistor having an inertial response using the equivalent noise circuit of Giacoletto ["Transistors I, RCA Laboratories," Princeton, N.J., 1956]. The charge model for the transistor is driven by large harmonic currents and supplemented with noise sources. The equivalent circuit contains a nonlinear diffusion capacitance, recombination resistance, and noise sources for the thermal noise of the base resistance, the noise from the recombination of carriers in the base, shot noise from the collector current and the noise current induced in the base circuits by carriers passing from the emitter to the collector. Differential equations are written and solved for the fluctuations of the collector and base currents in the large signal case using a Fourier series to represent the fluctuations.

The spectral characteristics of the transistor noise currents are then found analytically and then calculated on a computer for a sample case; graphs are plotted showing the variations in the spectral components of the noise currents as a function of the high frequency cutoff angle. It is shown that, as a rule, in practical calculations one can neglect the correlation between the noise referenced to the input and output, as well as between the component of the referenced noise in phase with the first harmonic of the output current and the component in quadrature to this harmonic. It is noted that a computer program developed from this approach is one of the basic subroutines for the calculation of the noise characteristics of large signal amplifiers, frequency multipliers and self-excited oscillators. Figures 4; references 8: 6 Russian, 2 Western.
[5-8225]

DIGITAL METHOD OF MEASURING NOISE LEVEL

KUZ'KIN, V. S. and PISKAREVA, I. I.

[Abstract] A proposed indirect method of digital measurement of the root-mean-square value (RMSV) of noise is described. The method, which has a sufficiently simple circuit realization, makes it possible to produce a higher precision of measurement in comparison with existing digital methods. The method is based on the replacement of direct measurement of the RMSV by measurement of the quantile of the noise distribution. A simplified block diagram of a device which realizes the proposed method of measurement of the RMSV of noise is presented. An evaluation is made of the precision of the quantile method. Although both the quantile and the classical method of measurement of the RMSV of noise are not optimum, the proposed method has a higher precision in comparison with the classical, and is also comparatively simple in digital realization. Figures 2; references 5: 2 Russian, 3 Western (1 in translation).
[30-6415]

USING MEASUREMENTS OF THERMAL RADIO-FREQUENCY EMISSION OF THE ATMOSPHERE TO
DETERMINE THE REFRACTION OF RADIO WAVES

GAYKOVICH, K. P., Scientific-Research Radio Physics Institute

[Abstract] An examination is made of the refraction of microwaves ($\lambda \leqslant 5$ cm) in the
atmosphere at angles of elevation of $1° \leqslant \theta_0 \leqslant 5°$. The method of analysis is based
on finding direct relations between the angle of refraction and the brightness tem-
peratures of atmospheric emission on a number of wavelengths and wave angles in the
form of equations of linear regression that also include statistical relations be-
tween refraction and ground-based weather parameters. Specific seasonal weather
statistics are used, and considered is given to the variation in atmospheric pres-
sure at ground level. It is shown that forecasts should be based on measurements of
air temperature and humidity near the ground rather than on the index of refraction.
A table is given showing the regression coefficients in the proposed formula for pre-
dicting refraction for the best combination of measurements and forecast error. Be-
cause cloud cover influences brightness temperatures, it is suggested that the fre-
quencies for observation be selected in a region where clouds do not affect radia-
tion, or alternatively that the influence of clouds on the brightness temperature
be accounted for. The author thanks A. P. Naumov for discussing the results, and
T. P. Kirasirova for assisting with the paper. Figure 1; tables 4; references 8:
6 Russian, 2 Western.
[312-6610]

SHOCK WAVES AND SOLITONS IN A TRANSMISSION LINE WITH MIS VARACTORS

MARCHENKO, V. F. and STREL'TSOV, A. M., Moscow State University

[Abstract] An examination is made of the peculiarities of formation of shock waves
and solitons in a transmission line in which the required wave process is enhanced
by using varactors as nonlinear elements. The capacitance-voltage characteristic
of the line is approximated by a piecewise-linear function that accounts for the
saturation of capacitance with strong signals. The varactors were MIS structures
based on $Al-SiO_2/Si_3N_4-Si$. Experiments were done on a line containing 30 cells,
each consisting of two varactors connected in parallel with total capacitances kept
constant within +3% as the voltage changed from 0 to -4 V. This range of bias volt-
ages corresponded to a critical frequency range of 13.5-19 MHz. Dispersion could

be varied by adjusting the inductive and capacitive coupling between cells. The results of the experiments show that transmission lines with MIS varactors have losses that are not much greater than when depletion-layer varactors are used. Shock waves and solitons are effectively produced in a low-frequency filter of this type with a critical frequency of around 10-20 MHz under conditions of weak dispersion. Figures 8; references 8: 7 Russian, 1 Western.
[312-6610]

INSTRUMENT FOR EVALUATION OF THE PARAMETERS OF A DISCRETE CHANNEL

ZOLOTAREV, Ya. M. and ZOR'YEV, A. D.

[Abstract]   According to data from three papers in the 1969, 1970 and 1972 literature, available instruments are not suitable for determination of the traffic carrying capacity and the operational readiness of a discrete channel. In the present short communication an instrument is described which makes it possible to measure these parameters. A block diagram and the principles of operation of this instrument are presented. A photograph is shown of the front panel the instrument ISKA (Statistical Channel Automatic Measurer). The left side of the panel is for evaluation of the quality of a discrete channel in its free state; the right is for measurement of the channel's characteristic when it is busy; the center is the common part. Figures 2; references: 3 Russian.
[30-6415]

METHOD OF EVALUATION OF ACCURACY OF TRANSMISSION IN SYSTEMS WITH DECISION FEEDBACK

GENKINA, N. F.

[Abstract] The possibility is considered of using boundary estimates for calcula-
tion of the exterior parameters in problems of the planning of data transfer systems
with decision feedback (SPD-ROS) on various communication channels. An analysis is
made with the aid of the theory of graphs of the reception-transmission algorithm
of SPD-ROS, and calculated relations for evaluation of the accuracy of transmission
in SPD-ROS are obtained. It is shown that during planning of data transfer systems,
for a choice of the type of error protection device (UZO) it is necessary to calcu-
late the required magnitude of the probability of information transfer because the
characteristics of data transfer systems depend to a considerable degree on a spe-
cific performance algorithm of the UZO. Satisfactory precision for engineering cal-
culation of this magnitude is given by lower boundary estimates of the probabilities
which characterize the quality of information transfer. The simplified method con-
sidered for evaluation with the use of the theory of graphs considerably reduces the
volume of computations as compared with locating precise values of these character-
istics. Figure 1; references 4: 3 Russian, 1 Western (in translation).
[30-6415]

ELIT-T TELEGRAPHIC DISPLAY

BOLOTNIKOV, V. N., KENIGFEST, L. A., REPINSKIY, A. M., SOLOVEYCHIK, I. Ye., SHITOVA,
L. A. and YARMARKIN, K. K.

[Abstract] The ELIT-T (electron-beam text indicator--telegraphic) is primarily in-
tended for use at prepunching operator's positions, reception of telegrams by tele-
phone, conversion of the format of telegrams and indexing of telegrams at message
switching centers. The ELIT-T also finds use in a whole series of communication
systems which conduct an exchange of data by telegraph channels. The operating con-
ditions of the ELIT-T are shown, its structure is briefly described with the aid of
a block diagram, and the technical characteristics of the device and preliminary
data concerning its economic effectiveness are presented. Figures 3; references:
5 Russian.
[30-6415]

STRUCTURE OF SWITCHING STATION WITH ELECTRONIC CONTROL

IVANOVA, O. N. and POPOVA, A. G.

[Abstract] The possibility is demonstrated of using electronic control for mechanical-electrical switching stations (SS), in which multiple coordinated connectors are used for switching the speech circuit. Choice of the structural circuit of the SS is considered. A block diagram of the SS is presented, in which the process of information reception is separated from the process of establishing a connection. Methods for construction of the register equipment of the station are described. The equipment of the control device is divided into two principal parts: peripheral and control. A block diagram of the overall control device is presented and the units which make up the peripheral and central control devices are listed. The principle of distributed control is used in order to assure the required reliability of operation of the SS. Figures 2; references: 4 Russian.
[30-6415]

TELEPHONE OPERATIONAL SYSTEM FOR ELECTRONIC SWITCHING STATION

GOL'DSHTEYN, B. S.

[Abstract] The special features are considered of a telephone operational system (TOS) which is used in electronic switching units. The principles of the design and configuration of TOS are outlined and a block diagram of TOS is presented. TOS is subdivided into a nucleus and environs. The nucleus consists of two complexes--a system of priority service and a system for organization of masses of lines. The hierarchy of interruption levels for a concrete version of a TOS is shown. At present the first version of a TOS for a pulse-time transit SS oriented to the electronic control machine "Neva" is undergoing operational experience. Figure 1; table 1; references 7: 6 Russian, 1 Western (in translation).
[30-6415]

MATHEMATICAL MODEL OF FUNCTIONING OF COMMUNICATION SYSTEMS ORGANIZED ACCORDING TO THE PRINCIPLE OF CONSECUTIVE OPERATIONS

BER, Yu. A., GRESHILOV, A. A., MATLIN, G. M. and TEREKHOV, V. S.

[Abstract] A mathematical model is considered of the technological process of communication which comprises a sequence of separate stages (a simple or complex circuit). It is shown that the model obtained can be used: 1) To determine the function of information arrival (quantity of services) at any stage, the unit output and the magnitude of debts in the case of a specified technological process and a known flow at the system input and pulse characteristics of the sections; and 2) To determine the optimum length of time of the stages, which assures a specified quality of functioning of the system with a known flow at the system input, and an assigned unit output quality and stages of the technological process. Solution of the problems makes it possible simultaneously to calculate the staff, the wage fund and other components of operational and capital outlays, as well as to determine the optimum technology for processing the load contained in a given unit output. An example is given of the use of the model for calculation of the debts for service assigned to credit. In particular this model can be used for calculations of the debts of subscribers of the residence sector for intercity telephone conversations. The authors express deep appreciation to G. B. Davydov for valuable recommendations and comments which made it possible to improve the quality of the work. [30-6415]

COMPONENTS AND CIRCUIT ELEMENTS,
WAVEGUIDES, CAVITY RESONATORS AND FILTERS

LOW-CAPACITANCE VARIABLE CAPACITOR WITH HIGH RESOLUTION

UVAKIN, V. F. and POL'SKAYA, I. P.

[Abstract] Capacitors with low variable capacitance of $(1 \text{ to } 10) \cdot 10^{-12}$ F and with
a resolution of $(1 \text{ to } 3) \cdot 10^{-15}$ F are required for certain measuring instruments and
radioelectronic equipment. A description is given of a variable capacitor design
in which the capacitor's electrodes are in the form of double-thread film surfaces
(a bifilar winding) on the outside cylindrical surface of a foiled film dielectric
of the FDM-3M type, inside of which is moved, on a moving fitting, the shank of a
micrometer installed on an insulated bracket. On an insulator ring surrounding the
film dielectric there are leads which are soldered to the capacitor's electrodes.
The bracket is designed so that the helical cylindrical electrodes of the capacitor
are arranged orthogonally to the screen of the measuring unit. The spacing of the
helical film surfaces is such that the depth of penetration of the electric field
is not greater than the diameter of the micrometer's shank. The cylindrical shank
can be made of metal or a dielectric, i.e., a ferroelectric. When a metal shank is
inserted the capacitor's capacitance is changed on account of its screening effect,
resulting in a reduction in the effective distance between the capacitor's elec-
trodes; when a ferroelectric is inserted, the capacitance is changed because of an
increase in the dielectric constant of the material between the capacitor's elec-
trodes. A variant is shown of a miniature capacitor with a fine thread on a dielec-
tric base and the head of a shank. Equations are presented for determining the
capacitance of a capacitor of this type. It is demonstrated that a capacitor of
this type is simple and small and has high resolution and a high Q with a consider-
able range of variation of capacitance. Equations are presented which make it pos-
sible to calculate static characteristics with a margin of error of two to five
percent. The ratio of maximum capacitance to minimum capacitance can be increased
without changing the size of the capacitor by reducing the thickness of the foiled
film dielectric and the air gap between the cylindrical shank and the film dielec-
tric. The paper was recommended by the Department (Kafedra) of Physics and Elec-
trical Engineering, Balakova Branch of Saratov Polytechnic Institute. Figures 2;
references: 4 Russian.
[14-8831]

A STUDY OF A WAVEGUIDE POLARIZATION FILTER

ZHURAV, S. M. and LOSEV, V. S.

[Abstract] One of the most effective polarization filters is a filter made of fine metal strips forming segments of plane waveguides. This paper analyzes such a filter when a plane wave is incident at any angle, and ascertains the impact of the finite thickness of the walls and the dielectric plate positioned above the strips on the filter parameters. It is assumed that the strips are ideal conductors and the plate is an infinite dielectric, while a scattering matrix technique is used to solve the problem of the filtering of the electrical and magnetic field components. The coefficient of ellipticity and the incident wave power passing through the filter are plotted graphically for the case of scanning across the strips, at an angle of 45° to the strips and along the strips. A sample calculation is made in order to ascertain the scanning sector of the filter without the dielectric plate and it is found that the maximum scanning sector in a given plane is determined by the spacing between the strips, where the sector narrows with an increase in this spacing. Optimum filter parameters are determined and it is noted that the presence of a dielectric plate does not permit shifting the regions of sharp changes in the values of the ellipticity coefficient and the power passing through the filter, which essentially govern the scanning sectors, but makes it possible through an appropriate choice of plate parameters within a scanning sector to increase these values. Plates with a high dielectric permittivity and a low height above the strips prove to be more efficient than plates at a greater height and having a lower permittivity. Figures 4; references 4: 3 Russian, 1 Western.
[5-8225]

A FIELD-EMISSION ELECTRON SOURCE MADE OF CARBON FIBER

FIALKOV, A. S., OSIPOV, N. I., ANASKIN, I. F. and KUPRIKOVA, N. D.

[Abstract] A study was made as to the feasibility of using carbon fiber as the cathode material for field emission of electrons. Polyacrylonitrile fibers 7-8 micrometer in diameter, manufactured in the Soviet Union and heat treated at 3000°C, were processed by treatment in an electric field with a disk anode at a potential variable from 1 to 5 kV. In this way a fiber fed by a micrometer screw mechanism

perpendicularly toward the anode was gradually shortened and its end tapered coni-
cally to a point. The process was monitored under a microscope. The minimum radius
at the fiber tip, 0.2-0.5 um, was attained with a voltage-to-distance ratio V/d =
1 kV/mm. With a larger ratio the cone became more slender, but the fiber tip over-
heated and its radius increased. Carbon fiber requires not as deep a vacuum as
does tungsten. Under a vacuum of $5 \cdot 10^{-8}$ torr the emission current was found to de-
crease with time, because of adsorption by residual gas molecules and ion bombard-
ment of the fiber tip surface. The stability of the emission current can be improved
by insertion of a high resistance, on the order of 10 MΩ, into the source circuit or,
even more effectively, by heating the fiber to 600-800°C during its operation. Fig-
ures 3; references 4: 1 Russian, 3 Western(1 in translation).
[21-2415]

THERMOELECTRIC COOLING MICROMODULES

ANATYCHUK, L. I. and NIKIRSA, D. D.

[Abstract] Thermoelectric micromodules are being produced for cooling and tempera-
ture stabilization of detectors, electronic components, integrated circuits, and
other miniature devices. They consist of thermoelectric batteries, 100-200 μm long
in the direction of current flow, on a ceramic (beryllium oxide) substrate building
the overall size up to $3 \times 3 \times 1$ mm^3. The thermoelectric cells are built on single
crystals of ternary compounds of bismuth telluride. The micromodules draw 0.3-1.0 W
while lowering the surface temperature of an object by 51-56 K within 100-300 μs.
Figure 1.
[21-2415]

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IMPROVEMENT OF THE PRODUCT ASSEMBLY PROCESS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 8, Aug 80 pp 45-46

ZAMYATIN, V. K., candidate of technical sciences

[Abstract] An All-Union conference was held in November 1979 at Leningrad on the subject "Scientific-Engineering Progress in Technology, Mechanization and Automation of Assembly Operations in Machine Production." It was organized by the Central and Leningrad Oblast administrations of the respective scientific-engineering departments of the machine manufacturing industry, by the Science Councils on machine manufacturing technology to the USSR Council of Ministers and to various individual ministries, and by the Commission on Machine Manufacturing Technology at the USSR Academy of Sciences. Over 300 specialists from the Soviet Union and 24 specialists from other CEMA countries participated in this conference. The topics included the state of the art in the electronic industry, the technoeconomic feasibility and application of new methods, the introduction of new equipment and tools, the manufacturability and quality analysis of products, problems of production targeting and standardization. Reports were given on the experience in assembly operations at the Moscow Automobile Manufacturing Plant imeni I. A. Likhachev and on the results of research done at the Department of Mechanical Technology at the Warsaw Polytechnic Institute (Poland). New concepts of particular interest include electromagnetic identification and channeling of parts, and capacitive sensing systems. At the conference the importance was emphasized of disseminating knowledge, training theoretical and practical specialists, and centralizing the production of the means of mechanization and automation for the assembly line.
[27-2415]

CONVERTERS, INVERTERS, TRANSDUCERS

A THERMISTOR-TYPE DISPLACEMENT TRANSDUCER

RAYTSAR, R. I.

[Abstract] A displacement transducer is produced for measuring linear elongations, displacements, and amplitudes of low-frequency vibrations. It consists of an elastic sensing element, a needle-like single crystal of a germanium-silicon solid solution 1 mm long and 25 micrometer in diameter with gold contact tabs, and a coaxially mounted miniature heater which establishes a temperature field with a certain given gradient. Linear motion of the needle in this temperature field causes a change in its resistance proportional to the displacement. This change of resistance is measured by a bridge circuit which also includes an indicating or recording device. The range of this transducer is up to 5 mm, its accuracy is within $7.5 \cdot 10^{-2}$ mm, its sensitivity threshold is 0.01 mm and its instability is within 0.3%. The nonlinearity of its output characteristic is within 1.5%, the output signal is 0-100 mV within the 0-30 Hz frequency range. Any other than linear output characteristic can be obtained by replacement of the crystal with another one having the appropriate thermometric characteristic. The operating voltage is 9 V, the power drawn not more than 2 W. The complete device weighs 100 g. Figure 1.
[21-2415]

A HIGH-SPEED CODE-TO-PHASE CONVERTER

MATYUSHIN, O. T.

[Abstract] A binary number X, proportional to a specified phase shift, is fed to the input of a code converter, which transforms the code of the number X to the codes of two numbers $S(X)$ and $C(X)$, approximately equal to the sine and cosine of the specified phase shift. The numbers $S(X)$ and $C(X)$ are converted by means of two

D/A converters to the voltages $u_B(X)$ and $u_C(X)$ which are then multiplied by the quadrature components of a har-onic reference frequency. The most important components of the code-to-phase converter are the initial code converter and the D/A converters, because theoretically they completely define the precision of the reproduceable phase shift and the speed of the device, i.e., the maximum possible phase change rate. This paper solves the problem of optimizing the precision of the channel generating the quadrature voltages $u_B(X)$ and $u_C(X)$, where the problem is reduced to finding the optimal logic functions of the code converter and the weights of the pair of D/A converters. The conclusions are: 1) The application of Walsh functions allows for the precise code-to-phase conversion of a harmonic signal with a limited number of D/A converter digits; 2) Designing the code-to-phase converter around Walsh functions simplifies the circuitry and increases its operational speed; 3) Rounding off simplifies the converter, but generates definite errors in the reproduction of the phase shifts; and 4) An optimal algorithm from the viewpoint of a minimum overall mean square error in the reproduction of the amplitude and phase is a rounding-off algorithm, which consists in rejecting expansion components having a relatively low absolute value. Figures 2; table 1; references: 4 Russian.
[314-8225]

DYNAMIC ERRORS OF A NANOSECOND CONVEYER-TYPE ANALOG-TO-DIGITAL CONVERTER

NOVITSKIY, A. P., Leningrad Polytechnic Institute

[Abstract] The dynamic performance of a conveyer-type 7-position analog-to-digital converter was studied in an Elektronika-100 minicomputer system for recording fast processes. Such a converter operates according to the "sequential multiplication of remainders" algorithm and feeds up to 2048 7-position words in the Gray code to the direct-access computer memory at a frequency of approximately 500 kHz. The converter was tested with rectangular pulses of 0.3-1 microsecond duration (40 nanosecond risetime and falltime) from a quartz-stabilized decade generator. The response was found to be approximately exponential with a damped periodic quasi-noise component. The converter was also tested with a sinusoidal signal from the same decade generator in order to determine the dependence of the level of dynamic noise on the signal frequency and thus on the rate of change of the input signal. The rms value of the dynamic noise was found to remain smaller than a unit of the least significant digit at signal frequencies below 150 kHz (0.5 V/microsecond) but to increase sharply above that frequency. The dynamic error is attributable to the inertia of coding discharges, which can cause switching of the less significant digits to cease and switching of the more significant digits to be delayed. Figures 6; references: 1 Russian.
[21-2415]

INVESTIGATION OF OPTICAL SYSTEMS OF DISPLACEMENT CONVERTERS BASED ON THE LIGHT FLUX ATTENUATION EFFECT

AZIMOV, R. K. and SHIPULIN, Yu. G., Tashkent Polytechnical Institute imeni Abu Raykhana Beruni

[Abstract] A description is given of an optoelectronic converter which can be used as a linear and angular displacement sensor, as a compensating and drive element in automation equipment, as a sensor for the position of bodies in space and in instruments for measuring levels and concentrations, as well as in other applications. This converter is based on the phenomenon of the absorption of light flux when it passes through hollow cylindrical light guides filled with materials acting as light shields and the inside surfaces of the guides have different reflection, or absorption, properties. In light guides of this type the light flux in them is absorbed both by the filling material, i.e., longitudinally, and by the inside surface of the light guide, i.e., transversely. On the basis of this, light guides have been developed with specific principles for the distribution of the light flux along the light guide and on the basis of the new types of optoelectronic converters have been created, including ones for converting large displacements. Equations are derived for the law of variation of illumination resulting from attenuation of the light flux in the longitudinal direction and for the change in the light flux resulting from transverse absorption by the inside surface of the light guide. A characteristic feature of the model of an optoelectronic displacement converter considered is the fact that the optical system consists of two sections of different types, one of which can move in relation to the other. An equation is derived which represents the static characteristic of the converter and makes it possible to analyze all of its key characteristics, such as its sensitivity and error. The operating principle of the converter is based on the redistribution of light flux from light sources to photodetectors by means of a moving light guide. The converter consists of two cylindrical chambers--a light absorbing one and a transparent one--at whose ends are placed light shields and light sources. At the center of the transparent chamber two silicon photodetectors are fastened and over this chamber a movable light guide with an inside reflecting surface is positioned. At the center of the moving light guide, on its outside surface, a ferromagnetic core is fastened, and on the outside surface of the light absorbing chamber an annular magnet is installed which moves and interacts with the inside ferromagnetic core. When the moving light guide is at the center of the transparent chamber, the illumination of the photodetectors is identical and the voltage in the output of the measuring circuit equals zero. When the light guide moves, the illumination of one of the photodetectors is increased and the other is reduced and at the output of the bridge circuit a voltage appears which is in relation to the amount of displacement. The light guide's displacement range is 0 to 2000 mm, the accuracy of reproducing displacements is 1.2 percent, and the sensitivity of the converter to light flux is 10 A/W. Figures 2; references: 5 Russian.
[22-8831]

CRYOGENICS AND SUPERCONDUCTIVITY

INVARIANT HIGH-FREQUENCY LEVEL INDICATORS FOR CRYOGENIC MEDIA

DEMIN, V. A., engineer, SEVERINOV, A. D., engineer, PYATIBRATOV, I. V., candidate of technical sciences, and UL'YANOV, A. S., candidate of technical sciences

[Abstract] The output characteristics of invariant high-frequency level indicators used in cryogenic media such as liquefied gases are subject to destabilization because of changes in the dielectric permittivity of the liquid and thermal strains which cause changes in the dimensions of the device. The problem has been partly solved by the development of a universal series of level indicators which covers the entire range of cryogenic from nitrogen through oxygen to hydrogen. For a complete solution of the problem, an algorithm of data-to-signals conversion in the transducer is here shown which ensures the necessary accuracy throughout this range by providing easy means of compensation and which is also relatively simple. The 2-channel resonance-type IRBU instrument, built at the Scientific-Research Institute of Instrument Manufacturing Technology in Smolensk, implements this algorithm with a maximum $\pm 1\%$ error caused by undercompensation of changes in the dielectric permittivity within the $\varepsilon = 1.2-1.6$ range and indicates levels of liquefied gases from 0.5 to 2.2 m with the use of an up to 100 m long cable connecting the probe to the electronic circuitry (amplifier-converters and computing devices) in a box outside. The instrument can be further improved by addition of a third channel and modification of the algorithm so as also to apply to a medium with phase transition, for indicating the level of the liquid-gas boundary where each phase has a different dielectric permittivity. The algorithm also eliminates the error caused by dimensional changes in the device caused by temperature changes, with the device designed structurally so as to make the result of signal conversion independent of the reference signals corresponding to a one-phase medium with $\varepsilon = 1$. Figures 2; references: 3 Russian.
[27-2415]

ELECTRICAL ENGINEERING EQUIPMENT AND
MACHINERY: APPLICATIONS AND THEORY

CALCULATION OF THE ELECTROMAGNETIC FIELD OF CONDUCTOR SHIELDS WITH SATURABLE REACTORS
IN THE STEADY STATE

GERASIMOVICH, A. N., candidate of technical sciences, dotsent, and BULAT, V. A.,
engineer

[Abstract] Transmission of electric energy from 200-1, 200 MW generators to step-up
transformers takes place over closed current conductors with shielding, each phase
in a separate continuous shield and all three shields tied together to ground at
both ends. While these shields reduce the power losses in surrounding metallic
structures, by suppressing the magnetic field outside the conductors, there appear
intrinsic power losses in them which also cause heating. These losses are in prac-
tice reduced by limiting the shield currents with saturable reactors in series.
During short-circuit faults, moreover, these reactors cease to be current limiting
due to self-saturation and, with shield currents now allowed to become approximately
equal to the conductor currents, they suppress destructive electrodynamic forces on
surrounding metallic structures. The design of shields and saturable reactors re-
quires calculation of the electromagnetic field. Here this is done on the basis of
the system of Maxwell differential field equations and the system of Kirchhoff non-
linear algebraic circuit equations. All quantities in the second system are func-
tions of the tangential component of magnetic field intensity at the outside sur-
faces of the shields, and they can be expressed analytically on the basis of the
solution to the first system. The resulting six equations are solved, with the aid
of matrix notation, by the iteration method. A computer program has been written
for this purpose which allows for varying the degree of compensation and yields the
reactor parameters. The paper was presented by the Department (Kafedra) of Electric
Power Stations, Order of Labor's Red Banner Belorussian Polytechnical Institute.
Figures 2; references: 6 Russian.
[28-2415]

A TRANSISTOR POWER SWITCH WITH TEMPERATURE LIMITATION RATED FOR 500 A AND 100 V

GRITSEVSKIY, Ye. A., MESHKOVSKIY, I. K. and TOGATOV, V. V., Leningrad Institute of
Precision Mechanics and Optics

[Abstract] A 500 A-100V transistor switch is described which consists of fifty 10 A
elements connected in parallel without any equalizers. Each element is a Darlington
transistor circuit with a temperature limiting thermistor, a PTC (positive tempera-
ture coefficient) $BaTiO_3$ thermistor being preferable for silicon devices and its
critical temperature lying within the 100-125°C range. The performance of this de-
vice was tested: its leakage current and current-voltage characteristic under
static conditions with forced cooling with an air stream of a 5 m/s velocity, its
ON and OFF switching times as well as reliability in a load stand under dynamic con-
ditions. At a voltage of 68 V it can switch a collector current of 350 A for 12 min
and at a voltage of 90 V it can switch a collector current of 510 A for 2.1 min be-
fore the thermal protector cuts out. The authors thank Yu. V. REZANOV and R. M.
BUDNITSKIY for assistance in performing the tests. Figures 3; reference: 1 Russian.
[21-2415]

ANALYSIS OF OPERATING CONDITIONS OF CHARGING UNITS WITH PULSE AMPLITUDE REGULATION OF THE OUTPUT VOLTAGE

PANFILOV, D. I. and IVANOV, V. S.

[Abstract] The operating conditions of charging devices for capacitive energy stor-
age elements exert a considerable influence on the technical and economic indicators
of charging units. It has been demonstrated that it is possible in principle, by
selecting operating conditions, to ensure the simultaneous optimization of both the
external characteristics and technical and economic indicators of charging units.
An analysis is made here of the influence of charging conditions on the installed
capacity of elements in one widespread charging unit circuit. Changes in charging
conditions are made by means of a control system without changing the structure of
the power section of the circuit. Fundamental relationships are derived for this
circuit under a number of conditions, making it possible to substantiate the selec-
tion of the charging mode for various design stipulations and to calculate and de-
sign charging units implementing the most advantageous conditions. The analysis is
based on the assumption that the transistor switches and rectifiers are ideal and
that voltage drops in the primary and secondary coils of transformers are not taken

into account. The charging unit is in the form of a system of transformers connected in parallel at the input and in series at the output. An analysis is made of the circuit's operation in the most general case when up to a certain stage the charging current is kept unchanged, and then the power consumed. A number of charging modes are arrived at by changing the ratio of the time during which the charging current is kept unchanged to the total charging time, whereby the limiting cases are the mode with an unchanged charging current and the mode with an unchanged consumed power. Equations are derived for the installed capacity of individual elements of the unit. It is shown that the lowest total installed capacity of a number of elements, i.e., of transistor switches, the transformers and the current-limiting transistor, belongs to the mode in which the current remains unchanged. A disadvantage of this mode is the high maximum power consumed. The lowest maximum power consumed belongs to the mode of unchanged consumed power, but here the total installed capacity of the elements listed above is higher. The data presented make it possible to select a charging mode satisfying a prescribed set of restrictions on such quality indicators as the power supply utilization factor and weight and overall size. The equations presented make it possible to determine all the parameters required for designing a charging unit with selected conditions. The paper was recommended by the Department (Kafedra) of Electrical Engineering, Moscow Institute of Electronic Techniques. Figures 2; references: 6 Russian.
[14-8831]

ELECTROMAGNETIC WAVE PROPAGATION, ELECTRODYNAMICS

DIFFRACTION OF A TWO-DIMENSIONAL WAVE BEAM BY A DOUBLE RIBBON LATTICE

PROSVIRNIN, S. L. and REZNIK, I. I., Institute of Radio Physics and Electronics, UkSSR Academy of Sciences

[Abstract] An investigation is made of diffraction of a wave beam by a double lattice formed by two simple ribbon diffraction gratings separated by a certain distance with the ribbons parallel to one another. Approximate formulas are derived for studying diffraction of a well focused gaussian wave beam by a dense double diffraction grating. The beam is represented as its decomposition into plane waves, and the known solution of diffraction of a plane wave by a double lattice is used. The field transmitted through the grating can be represented by exact analytical formulas if the lattice period is commensurate with wavelength. An analysis is made of the distribution of the transmitted field in the near zone, the shape of the directional pattern, the transmission factor and the width of the directional pattern as related to the distance between the simple diffraction gratings that make up the double lattice. Figures 7; references 7: 6 Russian, 1 Western. [312-6610]

DIFFRACTION OF A PLANE WAVE BY AN IDEALLY CONDUCTIVE BODY OF REVOLUTION WITH DIELECTRIC CLADDING

VASIL'YEV, Ye. N., SEDEL'NIKOVA, Z. V. and SEREGINA, A. R., Moscow Power Engineering Institute

[Abstract] The method of integral equations is used in analyzing diffraction of a plane electromagnetic wave by an ideally conductive solid of revolution covered with a dielectric layer. A system of integral equations is given in invariant vector form in which the unknown functions are the equivalent electrical and magnetic currents on the air-dielectric interface and the electric current on the ideally

conductive surface. This system is reduced to a system of algebraic equations with respect to the current density at discrete points. The method of cellular matrix inversion is used to solve the transformed system of equations. By enabling work with matrices of lesser order, this technique can be used in order to analyze diffraction of a plane wave by bodies of revolution of large electrical dimensions. An algorithm and computer program are developed for solving a system of complex equations of order 180. The specific problem of diffraction by a cylinder covered with a dielectric layer is numerically solved. The maximum length of the generatrix of the dielectric cladding is 5λ. It is shown that the physical pattern of phenomena when a field is diffracted by a cylinder covered with a dielectric layer is simple and graphic if near fields or equivalent currents are analyzed. These effects are determined mainly by the superposition of the incident and reflected waves, and the fields become more complicated only in the vicinity of the end faces of the cylinder. Figures 5; references: 6 Russian.
[312-6610]

SCATTERING OF ELECTROMAGNETIC WAVES BY THE NATURAL WAVES OF A SEMI-BOUNDED PLASMA

AZARENKOV, N. A., VOROB'YEV, V. M. and KONDRATENKO, A. N., Khar'kov State University

[Abstract] The authors investigate the instability of an rf electromagnetic wave skinned in a plasma relative to the swing of rf and lf waves in the fixed-phase approximation, and also the instability of a pumping wave of frequency $\omega_0 \leqslant \sqrt{2\Omega_1}$ ($\Omega_1 = (4\pi e^2 n_0/m_1)^{1/2}$) relative to the swing of ionic-acoustic surface waves. The increments and thresholds of the instabilities are studied. It is shown that the increment of an instability may be non-zero in the case of normal incidence of the external electromagnetic wave when it is decomposed into surface waves with opposed directions of propagation in the plane of incidence. However, if the pumping wave excites two ionic-acoustic surface waves of the same frequency propagating symmetrically relative to the plane of incidence, then instability will not develop with normal incidence. Figure 1; references 7: 6 Russian, 1 Western.
[312-6610]

AN APPROXIMATE SOLUTION OF THE PROBLEM OF DIFFRACTION AT A GRATING WITH A LIMITED
NUMBER OF STRIPS

LITVINENKO, L. N., PROSVIRNIN, S. L. and RESNIK, I. I., Institute of Radiophysics
and Electronics of the Ukrainian SSR Academy of Sciences

[Abstract] Because in a number of cases the dimensions of a grating can be less
than the width of the wave packet incident to it, the two-dimensional problem of
diffraction at a grating with a limited number of strips is solved. It is assumed
that in the direction in which the strips run the grating is unbounded and the field
incident to it is homogeneous. It is limited in the direction transverse to the
grating, while the phase and amplitude of the field incident to it can be a function
of the coordinates. The solution of the problem is based on an algorithm for the
diffraction of a wave packet from an infinite grating, which produces a sufficiently
precise algorithm for practical purposes and one which is simpler than the rigorous
solution found in the literature for the case of a limited number of strips ["Pre-
print No. 52 of the Institute of Radiophysics and Electronics of the Ukrainian SSR
Academy of Sciences," Kharkov, 1975]. The accuracy of the algorithm is determined
by comparing experimentals results from the literature with the approximate results
found here; good agreement is obtained and shown graphically, with the directional
pattern plotted of a field scattered by two strips for both the E and H polariza-
tions. The same comparisons are also made for a limited grating of 2, 5 and 10
strips, the widths of which are equal to the widths of the slots; the agreement is
also good here and the accuracy increases with an increase in the number of strips.
The approximation of the Fourier amplitude of the scattered field takes about 5
minutes of machine time on an M-222 computer; similar calculations using the rigor-
ous solution require N minutes, where N is the number of grating strips. A very
simple and approximate expression is also derived for the scattering cross-section.
Figures 2; references 6: 3 Russian, 3 Western(nslation).
[5-8225]

THE PROPAGATION OF MAGNETOHYDRODYNAMIC WAVES IN A THREE LAYER MEDIUM WITH CYLINDRICAL SEPARATION BOUNDARIES

MAKAROV, G. I. and SOLOV'YEV, O. V., Leningrad State University

[Abstract] A linear system of magnetohydrodynamic equations is used to describe the properties of an anisotropic plasma layer, where the direction of the external magnetic field H_0 in the plane of the cross-section of the cylindrical model is arbitrary. The two-dimensional formulation treats the case where the inner cylinder is ideally conducting, the surrounding gap is a vacuum, and beyond the gap is a magnetoactive plasma. Strict boundary conditions for the continuity of the tangential components of the electrical and magnetic fields are applied at the separation boundaries. The given model of the medium can serve for the analysis of the propagation of very low frequency electromagnetic waves near the earth in the plane of the magnetic meridian. The solution of the problem of the excitation of these waves by the magnetic current filament is accomplished in the form of a Debye series (an expansion in terms of the spectrum of the transverse operator) which reduces to an expansion relative to the normal waves using the well-known scheme of a Watson type transformation. By employing a VKB (expansion unknown) approximation, the nonuniformity of the slope of the lines of force of H_0 to the surface of the plasma layer is taken into account, so as to conform to the dipole nature of the geomagnetic field. The behavior of the expansion parameters for all possible directions of the vector H_0 is analyzed. No specific numerical examples are adduced. Figures 3; references 5: 3 Russian, 2 Western.
[5-8225]

THERMODYNAMIC EFFICIENCY OF THE LINDE CYCLE ON MIXTURES

LAVRENCHENKO, G. K., candidate of technical sciences, dotsent and TROTSENKO, A. V., candidate of technical sciences, dotsent.

[Abstract] One way to increase the efficiency of real refrigeration and cryogenic systems is to search for and use new working substances, pure ones or mixtures. An outstanding example is the Linde cycle, where replacement of a pure substance with a specially tailored mixture has increased the efficiency very significantly. There are several explanations given for this, all based on the stronger integral iso-thermal throttle effect at the ambient temperature. An analysis of the intrinsic losses in this cycle on an ideal binary or multicomponent solution reveals, more-over, that the coefficient of performance is a monotonic function of the mixture ratio and varies from the lowest to the highest with respectively the worst and the best component when used pure under the same cycle conditions p_1, p_2, T_0. Calculations based on the first two terms of the virial equation of state for a 0.75 Freon-14 + 0.25 Ar mixture, with $T_0 = 300$ K and $p_1 = 0.1$ MPa, confirm this conclusion. With p_2 also fixed, furthermore, a substance with a higher critical temperature will yield a higher coefficient of performance and so will addition of high-boiling components. The paper was presented by the Department (Kafedra) of Engineering Cryophysics, Odessa Technological Institute of the Refrigeration Industry. Figure 1; table 1; references: 7 Russian.
[28-2415]

TEST STAND FOR NUCLEAR POWER PLANT MAIN CIRCULATING PUMPS

VORONA, P. N., director, VNIIAEN (expansion unknown), and NIKITENKO, V. A., engineer

[Abstract] A description is given of a special stand designed and made for the pur-
pose of conducting tests on an experimental model of the main circulating pump (GTsN)
20,000 for a nuclear power plant with a type VVER-1000 reactor. This stand has a
maximum water flowrate of 25,000 m³/h at a temperature of 300°C and a pressure of
16 MPa and an installed capacity of 8000 kW. It includes the following basic sys-
tems, units and equipment: 1) An electric power supply system for the GTsN 20,000
drive motor and auxiliary equipment, including a 110/6 kV substation and a 6kV dis-
tributing network; 2) A unit for admitting distilled water; a cooling system with
air units and a water-cooling tower; 3) A main circulating loop with a gas volume
equalizer maintaining the working pressure in the loop; 4) A system for nominal and
emergency closing of the pump shaft's seal; 5) A unit for maintaining material and
thermal balances; 6) A unit for supplying water and air; 7) An oil supply system;
and 8) A system for monitoring and measuring parameters of the pump and stand. The
main circulating loop is in the form of a pipeline with an inside diameter of 850
mm and a total length of 60 m made in the form of a coiled vessel made of carbon
steel clad on the inside with 00Kh18N10T stainless sheet steel. A regulating valve
with a flowmeter is installed within it. The GTsN 20,000 pump unit is installed on
a rigid welded frame by means of a special swing support which makes it possible for
it to move in any direction as much as 120 mm, together with the main circulating
loop of the stand when heating and cooling. The 400-ton circulating loop is in-
stalled on five supports, four of which are yielding sliding bases which react both
to weight loads and forces of thermal expansion. The remaining mount is the fixing
point from which the circulating loop and pump move when heating and cooling. A de-
tailed description is given of the volume equalization system, the system for clos-
ing the pump shaft's seal, the heat balance unit and the oil supply system. The
stand makes it possible to conduct tests of an experimental model of the GTsN
20,000 in accordance with a special program, and at the same time test the capacity
for work, reliability and durability of individual components and parts and of the
pump unit under conditions close to operating. The testing program includes tests
of the electric drive motor, parameter studies of pumps with cold and hot water,
vibration tests and measurements of pressure pulsations, testing of the pump shaft's
sealing unit under various pressures and temperatures in the stand's loop, as well
as during simulation of emergency conditions, testing of bearings of the pump unit
and lubrication and cooling systems, determination of the pump's delivery during
rundown of the pump unit's rotor, and tests for the reliability of individual compo-
nents, parts and systems of the pump unit. It is also possible to make strength and
vibration studies under non-steady-state temperature conditions and to test various
materials in boron-containing water. Figure 1.
[10-8831]

INSTRUMENTS, MEASURING DEVICES AND TESTERS,
METHODS OF MEASURING, GENERAL EXPERIMENTAL TECHNIQUES

USE OF MOLECULAR MODULATION IN A SUBMILLIMETER RADIOSPECTROSCOPE WITH AN ACOUSTIC
DETECTOR

KRUPNOV, A. F., MEL'NIKOV, A. A. and SKVORTSOV, V. A., Institute of Applied Physics,
USSR Academy of Sciences

[Abstract] In a radiospectroscope with an acoustic detector (RAD), Stark modulation
in the usual arrangement of the Stark cell with flat parallel Stark electrodes pro-
duces spurious acoustic signals excited by electrostatic forces between the Stark
electrodes with square-wave voltage on the modulation frequency up to hundreds or
thousands of volts. To reduce this spurious effect, the authors test a design in
which a Stark electrode in the form of a stiff rod is placed on the axis of the
conventional cylindrical absorption cell, the walls of which act as the second elec-
trode. This configuration was found to reduce vibration and to enable recording of
spectra with Stark modulation. Experiments were done with a RAD in which source
modulation or molecular modulation could be realized at will. The resultant record-
ings show that noise level is virtually the same for both modes of modulation, and
spurious acoustic signals are eliminated upon switching to molecular modulation.
Figures 2; references 3: 2 Russian, 1 Western.
[312-6610]

IMPROVING THE SENSITIVITY OF A SCANNING SUBMILLIMETER RADIOSPECTROSCOPE WITH AN
ACOUSTIC DETECTOR BY USING A NONTUNABLE RESONATOR

KAZAKOV, V. P., Institute of Applied Physics, USSR Academy of Sciences

[Abstract] A method is proposed for improving the sensitivity of a submillimeter
radiospectroscope with an acoustic detector (RAD) by using a cavity resonator with
dimensions that are large compared with a wavelength. A multimode nontunable

resonator is used in the form of a copper cylinder with two fixed reflectors, one of which has diffraction coupling. Recordings made with the proposed modification show that sensitivity is enhanced without sacrificing scanning bandwidth. The results of this work were partially reported at the IV All-Union Symposium On Molecular Spectroscopy of High and Ultrahigh Resolution (Novosibirsk, 1978). The author thanks A. F. Krupnov for interest in the work. Figures 3; references: 3 Russian.
[312-6610]

A SELF-COMPENSATING INSTRUMENT FOR MEASURING THE TIME OF SIGNAL PROPAGATION

KHAMIDULLIN, V. K., BORTSOV, V. L. and RUDIN, V. V., Leningrad Institute of Aviation Instrument Building

[Abstract] An instrument is described which measures the ultrasonic velocity in a fluid medium on the basis of the signal travel time from radiator to receiver. The instrument includes an automatic regulation of the period of radiated ultrasonic pulses proportional to the pulse travel time through the medium. It consists of a trigger, a modulator, a controlled high-frequency voltage generator, two frequency dividers, two piezoelectric cells (one on each side), a rough-reading phase detector and a fine-reading phase detector. The operation is based on the relations $t_1 = L/c$ and $t_2 = 2^n T$ for the time in which the leading edge of a pulse train reaches the second piezoelectric cell and the output of the second frequency divider respectively, the generator frequency being accordingly $f = 2^n \frac{c}{L}$ (c denotes the measured ultrasonic velocity, L denotes the distance between the two piezoelectric cells, T denotes the period of the generator voltage, and n denotes the number of binary digits in the second frequency divider). The instrument measures the ultrasonic velocity accurately within $0.5 \cdot 10^{-3}\%$ in a fluid volume not larger than 20 ml. The generator tuning range is 3.5-4 MHz with a stability within ± 5 Hz at constant parameters of the medium, liquid or gas. Figures 2; references: 2 Russian.
[21-2415]

THE CORRELATION FUNCTION OF THE PHOTOELECTRIC CURRENT OF AN OPTICAL DOPPLER TURBULENT VELOCITY METER

GLAZOV, G. N. and IGONIN, G. M., Institute of Atmospheric Optics of the Siberian Department of the USSR Academy of Sciences

[Abstract] The increasing use of optical doppler velocity meters for the measurement of the dynamic characteristics of turbulent flows requires an analysis of the statistical structure of the photocurrent in order to optimize the meter circuitry and the interpretation of the measurements. A basic feature of the photocurrent as a random process is the correlation function or the energy spectrum Fourier transform related to it. This paper finds the correlation function of the doppler photocurrent of a differential optical velocity meter for a turbulent flow, with primary attention devoted to the incoherent component of the correlation function. Explicit expressions are derived for the function, the spectrum and their scales: the correlation radius and bandwidth. The random nature of the velocities, positions, dimensions of the particles in the dispersed and the number of them in the scattering volume, as well as possible asymmetry and misadjustments are all taken into account. In the meter configuration analyzed here, optical fields are mixed at the photocathode of the detector, where these fields are produced with the scattering of two mutually coherent laser beams by a two-phase turbulent flow in the field of view of the detector. The detailed mathematical analysis generates expressions for the useful photocurrent component, the correlation function of this component, the incoherent components of the correlation function and the doppler photocurrent spectrum and the coherent component of the correlation function. It is noted that the analysis of other meter configurations, for example, a circuit with a reference beam, differs in the case of turbulent flow in only a few details from that treated here. Figures 1; tables 1; references 15: 5 Russian, 10 Western(1 in translation). [5-8225]

FEASIBILITY OF USING SEMICONDUCTOR-TYPE DETECTORS BASED ON EPITAXIAL GALLIUM ARSENIDE FOR X-RADIOMETRIC ANALYSIS

GOLENETSKIY, S. P., ZALETIN, V. M., PROTASOV, I. I. and DUDAREV, A. T., Novosibirsk State University

[Abstract] The application of high-purity structurally nondefective epitaxial GaAs detectors, which operate efficiently at room temperature with an adequate energy resolution, is limited to x-radiation and "soft" Gamma radiation within the 5-50 keV range. Consequently, the feasibility was considered of using such detectors for x-ray analysis of chemical elements in the $Z= 23-63$ range. Experiments were performed with surface-barrier structures hermetically built into standard low-power transistor cases. The specimens had an active area of 3 mm^2 and an active zone 100-140 micrometer wide, with 200-250 V applied across the junction. Characteristic radiation of elements in the $Z= 26-42$ was excited by x-quanta from a 3-5 mCu strong Cd^{109} source and with Beta-particles from an open 100 mCu strong Pm^{145} source. The threshold sensitivity of these detectors, based on the K-series in the characteristic radiation spectrum of those elements, was found to be comparable with that of standard spectrometric proportional counters of the gas-discharge type. Their small size and long life, in addition to excellent performance at low voltage and room temperature, make them particularly suitable for ore prospecting and logging with portable instruments. Figures 3; table 1; references 10: 7 Russian, 3 Western. [21-2415]

AN AUTOMATED INSTRUMENT FOR SEMICONDUCTOR DIAGNOSTICS BY THE HELICON MICROWAVE METHOD

VITKUS, A. M., LAURINAVICHUS, A. K., POZHELA, Yu. K. and YASHINSKAS, P.-A.P., Institute of Semiconductor Physics, Lithuanian SSR Academy of Sciences, Vilnius

[Abstract] An instrument has been built for measuring the concentration and the mobility of current carriers in semiconductor ingots by the helicon microwave method. The specimen, of an arbitrary shape, must have one surface ground flat and this surface is pressed against the open end of a circular waveguide so as completely to cover the cross sectin of the latter. A helicon wave is excited by application of

a constant magnetic field to the specimen while circularly polarized electromagnetic radiation also impinges on it. The reflection coefficient is measured as a function of the magnetic induction and the readings are automatically recorded on magnetic tape for subsequent processing by a computer. The instrument includes a 36 GHz microwave oscillator with a 1 kHz meander-wave frequency modulator, as well as a rectangular waveguide joined to a circular one through a transition and a tee for joining both to a polarizer. The constant magnetic field is produced by an electromagnet with liquid-nitrogen cooling. The incident TE_{11} wave is linearly polarized. The reflected wave has circular polarization but, upon passage through the polarizer in the reverse direction, its polarization becomes linear at right angle to the polarization of the incident wave. A signal proportional to the reflection coefficient is produced by means of two channels: one for the reflected wave and one for the incident wave, both including a square-law detector and a synchronous detector. Also a directional coupler and an attenuator are in the second channel and an absorber of excess power in the first channel. Symmetrization is provided by matching subtractors with operational amplifiers. The digital voltmeter with a motor-driven commutator is controlled by a timer. The instrument range is carrier concentrations up to $5 \cdot 10^{21}$ m^{-3} at carrier mobilities from 10 m^2/V s up, depending on the maximum magnetic field intensity. Results obtained by this method do not differ by more than 20% from those obtained by the helicon resonance method or the Hall-effect method. Figures 3; table 1; references 10: 4 Russian, 6 Western(1 in translation).
[21-2415]

UDC 539.1.074.4

FEASIBILITY OF USING FIBER OPTICS AS AN EMITTER OF CERENKOV RADIATION

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 80 pp 72-73 manuscript received 1 Mar 79

REPENKO, Ye. V. and STUKOV, O. I., Scientific-Research Institute of Nuclear Physics at the Tomsk Polytechnic Institute

[Abstract] According to the performance characteristics of fiber optics and the mechanism of Cerenkov radiation from relativistic particles, passage of charge particles through an optical fiber should result in transmission of only the axial component of Cerenkov radiation. This was verified experimentally with the aid of a dual magnetic spectrometer and two scintillation counters with two coincidence circuits. A monochromatic electron beam with a 10x10 mm^2 cross section was passed through a fiber with a 10x20 mm^2 cross section. Measurements, with the aid of a photoelectron multiplier at one end, have revealed that the optimum transit angle is $\alpha = 1/\beta$ n (β denoting the ratio of velocity of particles to velocity of light and n denoting the refractive index of the medium) = 46°. The yield, ratio of recorded electrons to transmitted electrons, remains almost constant at the 0.45

level regardless of the fiber length from 150 to 500 mm and regardless of the electron energy from 30 to 200 MeV. In the case of very low electron energies, on the order of 0.8 MeV, and in very short fibers the losses become high as a result of a relatively strong drag and multiple scattering. Figures 2.
[21-2415]

PARAMETRIC-TYPE SOURCES OF A UNIVALUED STANDARD FOR A MEANDER REFERENCE VOLTAGE

ZAYDMAN, G. I. and PODKOPAYEV, N. N.

[Abstract] A description is given of a meander reference voltage source of the parametric type having approximately identical metrological parameters to ones described in earlier studies (1968 and 1976) but implemented with less equipment. A source of a univalued standard for a reference voltage is a key component of such equipment as digital voltmeters. A meander voltage is a rectangular alternating voltage whose effective and mean values are equal. The employment of a meander reference voltage source in measuring equipment is preferred in a number of cases, such as in measuring the parameters of an alternating-current signal by means of comparator circuits for the effective value, where it is possible to eliminate the transient error of the circuit. The reference voltage source discussed contains a multivibrator, a flip-flop operating in the register mode, a switching circuit, a d.c. voltage source and a diode voltage stabilizer. The reference voltage source's metrological parameters are determined chiefly by the diode voltage stabilizer, which utilizes temperature-compensated stabilitrons. A determination is made of the requirements for elements of the diode voltage stabilizer. The overall instability of a stabilitron is determined by the technology of its fabrication and equals $0.5 \cdot 10^{-2}$ percent over 5000 h for the best domestic type KS191 models. Equations are given for estimating the stabilization voltage of stabilitrons in the pulsed operating mode when calibrating them by utilizing direct current. Alteration of the stabilization voltage of a stabilitron in the pulsed operating mode is caused by variation in the temperature of its junctions. An equation is given for the peak value of the stabilization voltage taking into account transient processes in the pulsed operating mode of a stabilitron. A circuit diagram is presented for a highly stable parametric-type meander reference voltage source. The diode voltage stabilizer is a two-stage one assembled from temperature-compensated type D818Ye stabilitrons. An experimental meander reference voltage source of this type made it possible to achieve an effective voltage of 9 V with instability of this voltage of 0.001 percent, a load capacity of 10 mA, an output impedance of 0.03 Ω, a pulse repetition rate of 1 kHz, a leading edge length of 1 µs and output voltage instability with a ±10 percent variation in mains voltage of 0.001 percent. The paper was recommended by the Radio Engineering Department (Kafedra), Tomsk Polytechnical Institute. Figures 3; references 6: 5 Russian, 1 Western.
[14-8831]

ERRORS IN MEASUREMENT OF ION CONCENTRATION BY MEANS OF A CONDENSER WITH BLASTED STRAINERS

LASHMANOV, V. I., MONTIK, P. N. and KONOVALOV, S. A.

[Abstract] One variety of aspiration-type ion counter--a counter with blasted strainers--is discussed. Employment of the blasted strainer method makes it possible to reduce the size of the measuring condenser. The aspiration counter is in the form of a strainer-type cylindrical condenser, one of whose plates is grounded and to the other is supplied a negative potential of U. To the condenser, at a velocity of ω_0, is supplied ionized air or a contaminated aerosol. The radius of the strainer plates is R and the distance between them equals ℓ. The ions passing through the front strainer strike an electric field of $E = U/\ell$, which accelerates positive and retards negative ions. An equation of motion is given for the negative ions or aerosol particles and the time interval during which negative ions are stopped is determined. Also found is the distance an ion travels before stopping. If the magnitude of the field, E, is so selected that this distance is less than ℓ, representing the necessary condition for the counter's operation, then negative ions with mobility K, without reaching the second plate, turn back, settle on the first plate and are recorded by a galvanometer. The positive ions, entering the condenser, are accelerated by the electric field. In the condenser's measuring space three flows of ions occur: a stream of positive ions and two streams of negative ions--from left to right and from right to left. Equations are derived for the steady-state conditions for the motion of ions, taking into account the recombination of ions. It is shown that a methodical error exists which is caused by this method of measuring an ion concentration, because of the recombination effect. Also discussed is the error resulting from the effect of electrostatic induction. In measuring by means of the aspiration method an error can also arise, associated with the incorrect determination of the velocity of the stream of ions arriving at the measuring plate. This velocity is usually assumed to be equal to the rate of flow of the blasted air, which is true if the forces of viscosity are disregarded. An experiment demonstrated that ions in which $\omega_0 > KE$ slip through an aspiration condenser and are not recorded by the counter. With an increase in E, gradually for all ions $\omega_0 < KE$. The paper was recommended by the Department (Kafedra) of Electrical Engineering, Odessa Technological Institute imeni M. V. Lomonosov. Figures 2; references: 2 Russian.
[14-8831]

TIME INTERVAL MEASURING UNIT

KARPOV, N. R., MATYUKHIN, Yu. D. and POVARENKIN, N. N.

[Abstract] When employing the classical method of successive registration for mea-
suring time intervals, in which the interval to be measured is compared with a
standard discrete interval, by means of filling the interval to be measured with
pulses with a known calibrated repetition rate, asynchronism in the moments of ap-
pearance of these pulses relative to the beginning and end of the time interval mea-
sured results in a discreteness error. A description is given of a unit which re-
duces this discreteness error by utilizing the method of regressing coincidence.
This method consists in registering the number of return cycles the measured inter-
val completes in a closed circuit while reducing the length of the interval in each
return cycle by a calibrated quantity of time. The time interval to be measured
enters the inputs of a shaper and coincidence circuit and, as a sign-fixing signal,
all the bits of a reversible counter. In the absence of this signal, τ_x, the bits
of the reversible counter function in the subtraction mode, and in the presence of
the signal, in the summation mode. The pulses of the quantizing train, f_0, through
the coincidence circuit and an assembly unit, enter the high-order-bit input of the
reversible counter, which counts the number of quantizing pulses which fall within
time interval τ_x. The length of interval τ_x is determined by the equation $\tau_x = N \cdot T_0$,
where T_0 is the quantizing pulse repetition rate and N is the number entered in the
high-order bits of the counter. Two quantizing error components, $\Delta\tau_1$ and $\Delta\tau_2$, are
created because of indeterminacy in the position of time interval τ_x relative to
the quantizing pulses. The true value of the measured interval is $\tau_x = N \cdot T_0 -
\Delta\tau_1 + \Delta\tau_2$. Also, $\tau_x = N \cdot T_0 + \tau_1 - \tau_2$. To refine the result recorded in the high-
order bits of the reversible counter it is necessary to add a number proportional
to τ_1 and to subtract from it a number proportional to τ_2. For this purpose the
shaper forms two short pulses corresponding to the beginning and end of measured
time interval τ_x. A pulse corresponding to the beginning of the measured interval
enters a flip-flop and sets it to the "one" position, and the flip-flop is returned
to its original state by the next pulse of the quantizing train. From the output
of this flip-flop time interval τ_1 enters the input of an assembly unit to whose
output are connected in parallel two delay elements, with a signal delay time of T_1
and T_2, respectively, where $T_2 - T_1 = \Delta T$, representing the quantity defining the
discreteness of the measurement. The length of interval τ_1 is determined by the
equation $\tau_1 = N_1 \cdot \Delta T$, where N_1 is the number of return cycles. With N_2 equal to the
number of return cycles which pulse τ_2 completes with a reduction of its length in
each cycle by ΔT, when the circulation process is terminated, in the bits of the
reversible counter is entered a number proportional to the measured interval: $\tau_x =
N \cdot T_0 + \Delta T(N_1 - N_2)$. A circuit diagram is given of a circulating register assembled
from series 100 microcircuits. The delay elements are segments of RK-75-1 radio
cable with a delay of $T_1 = 26$ ns and $T_2 = 27$ ns, resulting in a discreteness error
of $\Delta T = 1$ ns. The quantizing pulse repetition rate equals $f_0 = 50$ MHz. The paper
was recommended by the Department (Kafedra) of Information-Measuring Techniques,
Ryazan' Radio Engineering Institute. Figures 3; references: 2 Russian.
[14-8831]

ON SOME POSSIBILITIES OF MICROWAVE RADIOMETRIC POLARIZATION MEASUREMENTS IN THE
SOLUTION OF INVERSE PROBLEMS

YEGOROV, S. T., POLYUSHCHEV, V. A. and YEGOROVA, Ye. S.

[Abstract] When using microwave radiometry to determine the electrophysical proper-
ties of target objects by means of brightness temperature measurements, one of the
possible sources of error is the failure to account for the complex nature of the
dielectric permittivity of the target. When the viewing angles and the sky tempera-
ture are known, a system of equations can be written in order to find the real and
imaginary components of the permittivity as well as the thermodynamic temperature
of the ground surface being studied. Then a system of equations can be derived for
specific viewing angles, permitting the determination of the complex permittivity.
This paper studies the stability of the solutions of these equations for the real
and imaginary components for the case of certain measurement errors. The technique
employs computer modeling of dry land covers in order to explore optimal viewing
angles and measurement accuracy. The precision in the determination of the thermo-
dynamic temperature for the case of errors in measurements of the absolute bright-
ness temperature is also analyzed and it is shown that for dry land, the measurement
accuracy of the thermodynamic temperature of objects in a range of viewing angles
from 55 to 75° is close to the precision of measurement of the brightness tempera-
ture, both with correlated and uncorrelated errors. For water surfaces, the best
accuracy in determining the thermodynamic temperatures is found for a complete cor-
relation between the measurement errors of the radio brightness temperatures in a
range of viewing angles from 65 to 75°. Thus, to measure the electrical parameters
of subjacent surfaces as well as their thermodynamic temperature, it is expedient
to design the radiometric system for the measurement of three values of the bright-
ness temperature, so that the greatest possible correlation is observed between
their measurement errors. Figures 3; references: 6 Russian.
[314-8225]

A RADIO ENGINEERING THERMOSTAT FOR OBJECTS WITH A LARGE THERMAL CAPACITY

GARYAYEV, S. N., KRAVTSOV, V. N. and CHEMES, Ye. A., Odessa Polytechnic Institute

[Abstract] A thermostat is described which has been designed for radio engineering equipment with a large thermal capacity. It is a double-wall chamber 440x170x130 mm^3 large outside and 380x110x70 mm^3 large inside. The walls are made of 5 mm thick aluminum strip, the space between them filled with a foam plastic. The heater is energized by the pulse-width-modulation method, i.e., with pulses of duration proportional to the magnitude of the temperature deviation from the reference point. The thermal probe consists of two thermistors connected in series in one arm of the instrument bridge. One thermistor is placed near the heater, the distance between them controlling the thermostat startup time as well as the temperature excursion inside, and one thermistor is placed intimately close to the object. Two variable resistors in the other arm of the bridge circuit set the reference temperature inside the chamber. With the bridge circuit elements and the d.c. amplifier placed inside the chamber, it is possible to maintain the temperature here within 0.01°C while the ambient temperature varies over the 0-50°C range. The amplified error signal is sent to a comparator which also receives a saw-tooth voltage from a pulse generator. The comparator produces pulses which, through an emitter follower and a transistor switch, feed the heater at a repetition rate of approximately 1 Hz only, so as to minimize noise as well as power dissipation in the transistors during transient periods. The 200 W heater consists of 20 resistors connected in series and spaced over the thermostat walls so as to ensure uniform heating of the object. Figure 1; references: 3 Russian.
[21-2415]

A CONTROLLABLE SEMIAUTOMATIC CLUTCH

YUSHIN, V. D., LOGVINOV, A. N. and CHEMPINSKIY, L. A., Kuybyshev Institute of Aviation

[Abstract] A controllable semiautomatic clutch has been designed for mechanical testing of specimens at constant high deformation rates in vacuum with an IMASH-5S-65 tensile machine, without the loading mechanism also having to be maintained under vacuum. The hub with axial pins is fastened to the driving shaft by means of a key

and a set screw. It screws into one end of the half-sleeve fastened to the driven shaft by means of pins. This shaft is threaded in the direction opposite to its rotation. A pair of counternuts on this shaft controls the position of the half-sleeve. A collar on the half-sleeve engages the latter with the hub after it has moved it from left to right during acceleration, whereupon another nut unwound by the driven shaft disengages it from the hub. The last operation occurs automatically. The device is simple and reliable. Figures 1.
[21-2415]

READOUT OF OSCILLOGRAMS OF ONE-SHOT FAST PROCESSES BY THE METHOD OF TRACKING CONVERSION IN A DISSECTOR TUBE

ARISKINA, R. A., FANCHENKO, S. D. and TSITOVICH, A. P.

[Abstract] A method of converting oscillograms to analog electric signals is described which involves intermediate storage of oscillograms in an electron-optical converter and subsequent conversion of the optical by means to a dissector television tube. The electron-optical converter is a brightness amplifier with a persistent luminescent screen. Image deflection in the dissector tube can be effected by either an electric or a magnetic field. Magnetic deflection was actually used, with the upper frequency limit at 2 kHz. The reading beam locks with the oscillogram at the instant of intersection. Tests were performed without a lock-in pulse but with regulation of the initial d.c. bias current, and with a lock-in pulse at the beginning of the horizontal sweep for leading the beam to the oscillogram from below. Figures 3; references 2: 1 Russian, 1 Western (in translation).
[21-2415]

INSTRUMENTS F R EASURING THE DRAG TORQUE OF MECHANISMS

GOLLANDTSEV, S. R., KOROTKIY, A. P. and MIROSHNIKOV, A. I., Moskinap Plant

[Abstract] The paper describes a drag torque meter (Fig. 1) based on determining the angle of twist of an elastic element that connects the shaft of the test mechanisms to that of the measuring instrument. The meter is an optical-mechanical device that converts the angular strains of an elastic element to displacement of a light beam over a scale. The shaft of the stand drive (e.g., electric motor 2) is secured to disk 3 coupled through elastic element 4 to another disk 5, which is fastened to shaft 6 connected to the item to be checked (not shown). In the disks are slits 7 and 8 in the form of sectors. On one side of the disks is a light source 9 with condenser lens 10, and on the other side is an optical system consisting of objective lens 11, stationary mirrors 12, 13, and scanning mirror 14 kinematically coupled to shaft 1 by gear couple 15, 16. The scanning mirror directs the light beam to a fixed screen with a scale that can be coated with a phosphor. A tachometer 18 is used to set and monitor the rpm of the motor 2. Scale 19 can be turned to adjust the beginning of readout. Under no-load conditions, slits 7 and 8 are diametrically opposite, so that no light passes through. When the mechanism to be checked loads the system, the scale shows the fraction of the overlap of the two slits, which corresponds to the drag torque of the mechanism.

Figure 1
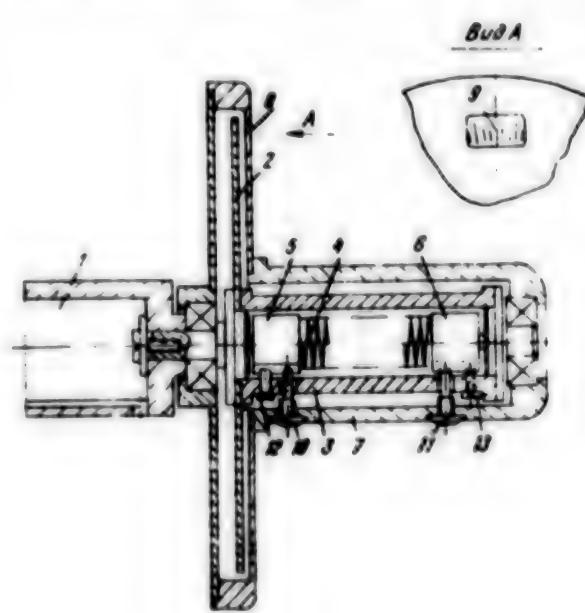
Figure 2

Figure 2 shows a spring dynamometer for measuring the drag torque of friction take-up mechanisms. The working principle of this device is based on measuring the angle of twist of an elastic element for determining the drag torque of reversible friction drives regardless of the direction of motion. The dynamometer is secured by sleeve 1 to the output shaft of the friction drive (not shown). Casing 7 is turned with a fixed position of the friction input shaft to set up a certain torque on the elastic element that starts slipping of the friction drive. This slip is registered by scale 2. When sleeve 1 rotates clockwise, the end of the spring that is connected to sleeve 6 is held back by screw 11. The other end of the spring that is connected to sleeve 5 turns freely together with casing 3 relative to casing 7, twisting the spring through a certain angle that depends on the torque applied to sleeve 1. When sleeve 1 turns counterclockwise, the end of the spring connected to sleeve 5 is held back by screw 10, and the other end turns freely, twisting the spring in proportion to the applied torque. Figures 4; references: 2 Russian. [313-6610]

CALCULATION OF THE THERMOPHYSICAL PROPERTIES OF A NEW CLASS OF COMPOSITE MATERIALS
BASED ON METASTABLE SOLID SOLUTIONS OF INERT GASES IN ALUMINUM

ZARICHNYAK, Yu. P.

[Abstract] An assessment is made of the feasibility of calculating the thermophysi-
cal properties of a class of composites produced by heat treating metastable alloys,
i.e., solid solutions, of metals with inert or other gases. The heat treatment of
a metastable solid solution makes it possible to regulate its density, thermal con-
ductivity and diffusivity over a wide range by adding a small quantity of additions
of the regulating gas component. An example of composites of this sort is the meta-
stable ternary system Al-Ar-O with a composition of 0.05 to 1.0 percent by weight
of argon and 0.01 to 6.6 percent by weight of oxygen. Here the argon and oxygen
are added to the aluminum by treatment in the cold plasma of a gas discharge. The
argon forms with the metal a supersaturated solid substitutional solution and the
oxygen is bound in the form of dispersed oxide inclusions. The results are given
of a measurement of the thermophysical properties of composites of this sort, illus-
trating the influence of heat treatment. It is assumed that with low porosity the
gas pores are primarily of a closed nature. A model of a structure with closed
impregnations is used for calculating the effective thermal conductivity. A model
with interpenetrating components is used to calculate the properties of a structure
with connecting pores. The following equation is given for calculating the effec-
tive thermal conductivity of a porous composite at a specific temperature: $\lambda =$
$\lambda_1 m_1^2 + 2m_1 m_2(2\lambda_1\lambda_2/(\lambda_1 + \lambda_2)) + \lambda_2 m_2^2$, where λ_1 is the thermal conductivity of a mono-
lithic metastable solid solution, λ_2 is the thermal conductivity of the gas compo-
nent and m_1 and m_2 are the volumetric concentrations of the solid and gas (the por-
osity) components in fractions, where $m_1 + m_2 = 1$. It is demonstrated that this
equation can be recommended for predicting the thermal conductivity of composites
of this class both at the planning stage of a material and for testing and general-
izing the results of measurements. An equation in general form is given for a meta-
stable solid solution formed by means of various gas components. The paper was
recommended by the Department of Thermal Physics, Leningrad Institute of Precision
Mechanics and Optics. Figure 1; references: 5 Russian.
[14-8831]

THE DESIGN OF THE COMPONENTS OF OPTOELECTRONIC PROTECTION CIRCUITS FOR POWER SUPPLIES

LEVINZON, S. V.

[Abstract] A combination of a light emitting diode and a photothyristor are used as an optoelectronic switch in order to control rectifiers of a 50 Hz AC power supply. Such optoelectronic protective circuitry make it possible to simplify the design of the protective device and to assure effective supply protection, combining the regulation and rectification functions during normal operation. A simple modification of a protective circuit involving the insertion of a capacitor in order to reduce the disconnect time for the protective circuitry by about two orders of magnitude is described. A detailed mathematical analysis is made of the design of the overload sensor and the components of the protective circuit, as well as the control circuits for the thyristors of the rectifier bridge. The derived analytical expressions are applied to the sample case of a 120 volt, 1 amp rectifier using a 30U103V photothyristor. Schematics of the proposed rectifier and protective circuitry are shown. Figures 2; references: 5 Russian.
[314-8225]

MODEL PIM-103 ELECTRON-OPTICAL CONVERTER

V'YUGINA, T. S., KLEPOV, A. F., KONDRASHEVA, L. I., LEBEDEV, V. B., STEPANOV, B. M. and FEL'DMAN, G. G.

[Abstract] The model PIM-103 pulse-type electron-optical converter is designed for recording fast processes at visible and infrared wavelengths. Its time resolution as a photochronograph is 10 ps and its maximum speed as a camera is of the order of 10^7 frames/s. The device includes an asymmetric electronic shutter of the

deflection type compensated within 10%, as well as a system of vertical and horizontal image scanning. The electron-optical magnification is $2\pm10\%$, the active area is 8×8 mm^2 on the photocathode and $50(\text{dia})\times50$ mm^2 on the screen. The accelerating voltage is 15kV nominal and 20 kV maximum, the focusing voltage is 200–350 V above the cathode, the image blanking voltage is 700 V. The sensitivity to voltage changes is 0.06 mm/V at the shutter plates and at the compensating plates, $0.03\pm10\%$ at both first and second pairs of image scanning plates. The bandwidths are 500 MHz of the shutter plates, 450 MHz of the compensating plates, 400 MHz of the first pair of deflecting plates, and 300 MHz of the second pair of deflecting plates in the 75 channel. Figures 1.
[21-2415]

LOSS OF RESOLVING POWER BY ELECTRON-OPTICAL CONVERTERS WITH ELECTROMAGNETIC FOCUSING AFTER LENGTHY EXPOSURE

AFANAS'YEV, V. L. and PIMONOV, A. A., Special Astrophysical Observatory, USSR Academy of Sciences, Zelenchukskaya

[Abstract] Electron-optical converters with electromagnetic focusing are used in astrophysics as receiving devices for the study of weak objects. Here the dependence of their resolving power on the instability of the current in the magnetic lens and on the instability of the accelerating voltage is analyzed in terms of scale distortions after lengthy exposure as the decisive factor. On the basis of the solution to the system of two linear algebraic equations for the displacement of the diffusion circle, in the approximation of geometrical optics, and on the basis of an allowable scale distortion not exceeding one quarter of the circle radius, the maximum allowable current instability and voltage instability are estimated. In order to attain the necessary stability, $|\Delta I/I|$ within $5\cdot10^{-5}$ and $|\Delta V/V|$ within 10^{-4}, a source of accelerating voltage with external excitation through a transformer and a set of transistor switches as well as a source of lens current have been built. The stabilizing element in both is an error amplifier with feedback. Current fluctuations are also suppressed by a large capacitor across the lens. Both sources have been designed for operation with M9-ShchV and UM-92 electron-optical converters. Figures 3; references: 7 Russian.
[21-2415]

UDC   534.86:006(100)+681.84.006(100)

THE INTERNATIONAL ELECTROTECHNICAL COMMISSION AND STANDARDIZATION IN ELECTROACOUSTICS
AND AUDIO ENGINEERING IN MOTION PICTURE MAKING

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 7, Jul 80 pp 47-53

BELKIN, B. G., All-Union Scientific-Research Institute of Motion Picture Photography

[Abstract] The article discusses the part played by the International Electrotechnical Commission (IEC) in setting standards for electroacoustics and sound equpment in the motion picture industry. A brief overview is given of the history of the IEC and its relationship to the International Standards Organization (ISO) in the UN. The IEC now includes 42 nations, and encompasses 190 technical committees and subcommittees. Standardization problems that are now being handled by the Commission include: symbols, units and nomenclature; standard methods of measurement; technical specifications of items and methods of checking them; standardization of the characteristics of items in order to ensure electrical and mechanical compatibility and interchangeability; accident prevention. An outline is given of the organizational structure of the IEC. The work of some of the committees and subcommittees is briefly discussed. Mention is made of IEC publication No 581, which is now under preparation. This standard will spell out individual requirements to be satisfied by various elements of sound equipment in the "Hi-Fi" class. The author was assisted in preparation of this article by members of the Soviet Committee of the IEC, M. P. Andrianova and A. A. Vinogradova. Figures 4; tables 4; references: 2 Russian.
[313-6610]

THE POWER CHARACTERISTICS OF THE COMBINING OF THE POWER OF SEMICONDUCTOR MICROWAVE OSCILLATORS

PONOMAREV, L. I. and YEL'TSOV, A. K.

[Abstract] The output of individual oscillators is combined so as to boost the power of microwave devices. This paper analyzes the impact of the scatter in the parameters of semiconductor microwave oscillators on the power characteristics of the combining circuitry, working into a resonant load. It is assumed that the outputs of the individual oscillators are combined in phase with the resonant frequency of the combining circuit. An expression is derived for the optimum coupling coefficients of the nonidentical oscillators connected in parallel, though it is noted that the realization of optimum coupling for each oscillator is difficult in practice, so the subsequent analysis is predicated on identical coupling coefficients for all oscillators. An analytical expression is derived for the quantitative estimate of the efficiency of the combining of the oscillator powers and two cases are differentiated for this efficiency as a function of the scatter in the parameters. It is briefly noted in conclusion that experimental studies of a system of three avalanche transit time diode oscillators optimally coupled to a common resonator showed that with a scatter of the output powers on the order of 30%, the efficiency in combining them was practically unity, which is in agreement with the theoretical results of this paper within the measurement accuracy. Figures 2; references: 2 Russian. [314-8225]

FLUCTUATIONS IN A SELF-EXCITED OSCILLATOR USING A LOOSELY COUPLED RESONANT CIRCUIT

TSARAPKIN, D. P. and KARUTIN, N. V.

[Abstract] Equivalent circuits are drawn for self-excited oscillators designed
around a Gunn diode and an avalanche transit time diode in order to show that such
oscillators are described by practically identical truncated equations. Analytical
expressions are derived for the random deviations of the output voltage amplitude
and phase, as well as the power spectra of the fluctuations in the amplitude and fre-
quency of the output signal. The conclusion that there is a significant rise in
the frequency noise of such oscillators for the case of a frequency difference of
several units of the generalized ratio representing the detuning from the resonant
frequency was checked with an experiment using a Gunn diode oscillator in a wave-
guide. The waveguide had a cross-section of 23 x 7 mm, operated at 9 GHz and had
a loaded Q of 200. The resonator was tuned by a varicap in a range of ± 1.5 MHz.
The modulation sensitivity of the oscillator was measured as a function of the modu-
lating frequency, which is shown graphically with the relative change in the peak
frequency deviation as a function of this modulation frequency. Good agreement is
noted between experiment and theory in predicting oscillator behavior; the common
features are noted of the noise behavior of crystal controlled, transistorized and
vacuum tube, decimeter wavelength oscillators, as well as the above mentioned types.
Figures 3; references: 7 Russian.
[314-8225]

PHOTOELECTRIC PHENOMENA AND DEVICES,
ELECTROLUMINESCENCE, ION DEVICES

WIDENING THE DYNAMIC RANGE OF A PHOTODIODE PHOTODETECTOR

DRUCHEVSKIY, V. A., KRASNOV, A. A., MALYSHEVA, N. V., MATVEYEV, I. N. and POLETAYEV, B. V.

[Abstract] A photodetector is proposed intended for reception of optical pulse signals of 5-20 microsecond duration with pulse repetition rates from 100 Hz to 10 kHz. The dynamic range of the FD-8K silicon photodiode serving as the detector is widened by application of an automatically controlled forward bias voltage from an external source. The device also includes an amplifier based on a field-effect transistor and a microcircuit operational amplifier. The feedback circuit, which consists of a reverse-biased diode and a capacitor, regulates the forward bias on the photodiode according to the power level of the input signal. This arrangement extends the dynamic range to approximately 50 dB; it is only approximately 20 dB with the automatic control loop open. Figures 2; references: 4 Russian.
[21-2415]

MEASURING THE PERFORMANCE PARAMETERS OF INFRARED HETERODYNE PHOTODETECTORS

BIRYULIN, P. V.

[Abstract] A method of measuring the threshold sensitivity of heterodyne infrared photodetectors is proposed, with the radiating black body placed in the far zone relative to the receiver so as completely to cover the field of vision of the latter. Relations for the radiation power and the signal-to-noise ratio are derived from this condition. The instrumentation includes as the black body radiator a cylindrical cavity of oxidized stainless steel with a corrugated bottom heatable to 1100 K, and a one-frequency CO_2 laser as the source of heterodyne radiation, as well as a

filter as the integrator, an 80 Hz modulating disk, a reference photodiode and a pre-amplifier for the recording system. Two versions of the latter are shown: one including an intermediate-frequency amplifier, a square-law detector, an instrument voltage amplifier and a voltage converter-meter; the other including only a noise factor meter controlled by an externally triggered 80 Hz meander-wave voltage generator. With this instrument were measured the threshold sensitivity of a $Cd_{0.2}Hg_{0.8}Te$ photoresistor as a function of the heterodyne power and the radiation pattern of such a heterodyne photodetector as well as the intensity distribution in the heterodyne beam, both at a distance of 0.6 m from the beam splitter. The author thanks V. S. DZYUB for assisting with the measurements. Figures 3; references 9: 6 Russian, 3 Western.
[21-2415]

MODES OF OPERATION OF AN ELECTROOPTICAL MODULATOR DURING INVESTIGATION OF THE FREQUENCY CHARACTERISTICS OF PHOTODETECTORS

BIRYULIN, P. V.

[Abstract] The frequency characteristics of photodetectors are studied with the aid of laser radiation modulated by an electrooptical modulator. The residual luminous flux leaking through to the modulator output because of imperfections is, although usually disregarded, sometimes quite significant. This is demonstrated in the case of modulator operation under a voltage which has a d.c. component and an a.c. one, with the level of the d.c. voltage usually selected so as to yield the maximum alternating flux with the minimum nonlinear distortion. Because of the residual constant flux, however, this mode of operation is not optimal for the study of photodetectors and it becomes necessary to attenuate the total flux. It is most expedient to reduce the constant component, i.e., the d.c. voltage. The alternating component will then also decrease but not as much and the depth of modulation will even increase. The theoretical results have been verified in an experiment with an ML-7 electrooptical modulator on a GaAs crystal (wavelength 10.6 micromotor, half-wave voltage 3 kV) and a CO_2 laser (power 2 W), measuring the frequency characteristics of a CdHgTe photodetector. The author thanks Yu. D. SAMORODOV for discussing the study and I. A. GORN for assisting with the measurements. Figure 1; reference: 1 Russian.
[21-2415]

POWER SYSTEMS (INCLUDING EFFECT OF VARIOUS ITEMS ON POWER TRANSMISSION)

FRACTURE OF PIN INSULATORS CAUSED BY ACTION OF PULSE CURRENTS

GEL', P. V., dotsent, Vinnitsa Polytechnic Institute, SOBCHUK, V. S., engineer, and STRAZHNIK, V. A., engineer, Vinnitsa Eastern Electrical Systems Enterprise

[Abstract] Insulators on reinforced-concrete supports along 10 kV overhead trans- mission lines are found to fracture after breakdown caused by pulse currents. The mechanism of defect buildup to the point of fracture has already been established on the basis of the model of a cylindrical compression shock wave propagating and building up in a solid dielectric because of pressure on the walls of a capillary in it passing a discharge current, with radial and annular cracks produced where such compression waves and tension waves traveling in the reverse direction from the insulator surface intersect. Now an experimental study was made on ShF-20V porce- lain insulators (minimum secondary breakdown voltage 56 kV), to which current pulses of 10^2-10^4 A amplitude and of the order of 10^{-4} s duration were applied at the High- Voltage Engineering Laboratory of the Vinnitsa Polytechnic Institute. Oscillograms reveal that defective insulators will fracture when the amplitude of the pulse cur- rent reaches 250-300 A. Testing insulators with such currents is an effective meth- od of detecting those with hidden defects. The paper was presented by the Depart- ment (Kafedra) of Electrical Systems, Vinnitsa Polytechnic Institute. Figures 2; references: 5 Russian.
[28-2415]

USE OF CONTROL COMPUTERS FOR RELAY PROTECTION OF ELECTRICAL EQUIPMENT

POLYAKOV, V. Ye., doctor of technical sciences, professor, and SHTEYNFER, Ye. G., engineer

[Abstract] Inclusion of a control computer for data processing in an autonomous protective relaying system should increase both the efficiency and the reliability of such a system by reducing redundancy. Here this is demonstrated on an electric transmission line, the protection system of which includes high-frequency differential-phase relaying and 3-step distance relaying as well as ground-fault protection and interphase-current cutoff. A tautological organization of relayed signals concerned with the state and the symptoms of the line is shown, according to the method of reduced basis and with a proper extension of it, which covers all possible relations between the set of allowed signal combinations and the corresponding set of diagnoses so as to eliminate also all forbidden symptom combinations. Such an organization facilitates the synthesis of a tripping logic and the corresponding computer command system without unnecessary as well as protracted cutouts in a selective protection system. The paper was presented by the Department (Kafedra) of Electric Power Plants, Networks and Systems, Order of Labor's Red Banner Ural Polytechnic Institute imeni S. M. Kirov. Figures 1; references: 3 Russian.
[28-2415]

PRODUCTION TECHNOLOGY

"KERAMIKA" EQUIPMENT FOR SURFACE METALLIZATION OF METAL OXIDES AND THEIR SYSTEMS

NEPOKOYCHITSKIY, A. G. and TUKMACHEV, G. V.

[Abstract] "Keramika" apparatus for metal coating of metal oxides such as ferrites and ceramics includes equipment for electrochemical reduction of the surface at current densities up to 20 A/cm^2, with or without its plasmochemical activation at current densities up to 100 A/cm^2, followed by autocatalytic and galvanolytic deposition of the metal film. The latter undergoes slight plastic deformation in a separate device. As the anodes serve a lead cylinder for reduction and a copper or nickel cylinder for galvanodeposition. Rotation of the object in the electrolytic bath with a radial electric field geometry or prefilling of its pores with the coating metal facilitates the deposition of a homogeneous film of uniform thickness. Figures 2.
[21-2415]

USE OF AN AUTOMATIC RATIONER IN THE PRODUCTION OF INTEGRATED CIRCUITS

REAZANOVA, O I., candidate of chemical sciences, BOBKOV, G. A., engineer, and VAVRZHINA, S. V., engineer

[Abstract] In the manufacture of integrated circuits various materials such as photoresists, varnishes and adhesives must be deposited in measured quantities. Use of an automatic rationer in large-scale production reduces inaccuracy and variability as well as waste due to overdosing. Such a device has been developed at the Yaroslavl Design Technological and Scientific-Research Institute for this purpose which dispenses the material by action of a pneumatic pulse of definite pressure and duration, the dose being determined by the viscosity of the material and the air pressure as well as by the length of dispensation time and the syringe diameter and length. The tool is controlled electrically, by a timer which puts out a voltage pulse and by a current regulator. It includes a reservoir with the syringe

and an ejector vacuum pump for preventing discharge between dispensations. The tool was tested in the production of chips on silicon wafers. Deposition of a 0.9 micrometer thick film of FP-383 photoresist on an area 60 mm in diameter from a centrifuge rotating at 3000 rpm was found to require 0.5 g of the material and a syringe 0.57 mm in diameter operating under a pressure of 1.4 kgf/cm^2 for 0.2 s. The parameters are different for deposition of other materials. Use of this tool for K1IP1 integrated circuits should increase the production rate three- to four-fold, depending on the operation. Tables 1.
[27-2415]

PROSPECTS AND PROBLEMS OF NUCLEAR POWER MACHINE BUILDING AT THE 'IZHORSKIY PLANT' PRODUCTION ASSOCIATION

MASLENOK, B. A., candidate of technical sciences

[Abstract] At the "IZhorskiy Plant" Production Association an ASEA unit has been put into operation for the additional degassing, refining and buildup of molten metal, so that now it is possible to produce forging ingots weighing as much as 400 tons. Scheduled for the next few years is a new drop forging shop which will make it possible to increase the dimensions of nuclear power plant equipment parts and to reduce the labor intensiveness of forging and welding operations and of machining. A new technology has been introduced for making the shell of a pressure equalizer so that it is now made of 4 courses instead of 5, resulting in the use of 438 tons of metal instead of 472 and in 5 welded seams instead of 6. The collector of the steam generator of the VVER-1000 reactor is now made out of two parts instead of three. The labor intensive facing operation has been eliminated by using bimetallic rolled metal in the form of sheets and tubes. The mechanization of welding operations at the plant has been increased by 10 to 15 percent, the manufacturing cycle has been shortened and product quality has been improved. Welding and facing operations have represented 30 percent of the total work going into making nuclear power plant equipment. Welding shops, sections and crews have been specialized in terms of the kinds of products they produce. The introduction of new equipment and of measures for overall automation and mechanization of welding processes has made it possible to increase the mechanization of welding operations in 1979 to 80 to 85 percent. Measures to improve testing equipment have been introduced, along with nondestructive testing methods. High-efficiency general-purpose and unique machine tools with program control have been introduced. Ways have been found to improve VVER-1000 equipment, such as simplification of the layout of the first circuit by means of elimination of the main gate valve, the unification of design solutions and materials used for various modifications of nuclear power plant projects and the improvement on the basis of advanced technology of designs tested under actual operating conditions in order to produce the best results with regard to improving operating reliability in combination with production efficiency. Key technical

measures taken at the association in 1975-1979 include the electroslag welding of
connecting pipes on VVER-440 pressure compensators and on RBMK-1000 steam separator
drums, to replace manual welding. This has resulted in the practical elimination
of additional work associated with the correction of defects. Automatic welding
and facing processes have replaced manual processes in many applications. Figures
6; references: 2 Russian.
[20-8831]

INFLUENCE OF INDUSTRIAL NOISE ON PERFORMANCE OF ULTRASONIC INTERNAL FLAW DETECTORS

RASSUDOVA, T. A., GORODKOV, V. Ye., KOSIVTSOV, N. Ye. and TKACHENKO, V. A., engineers

[Abstract] The results are given of a study made by the "Atomkotlomash" Scientific
Production Association on electromagnetic and electrical noise influencing the per-
formance of ultrasonic internal flaw detection equipment under production condi-
tions at the Krasnyy Kotel'shchik [Red Boilermaker] Production Association in
Taganrog. Measurements were made with an LMZ-3 noise meter, whereby an estimate of
the extend of noise was made in terms of the field level and voltage level of the
noise. Measurements were made in the frequency range of 0.15 to 30 MHz of the noise
field level, i.e., of the vertical component of the electrical field strength and
the horizontal component of the magnetic field strength, and of the noise voltage
level. Measurements of the noise voltage field were made with rod and loop antennas.
The rod antenna was used to measure the electric component of the noise field, where-
by all the noise received by the antenna over a period of 3 minutes was recorded at
each of the frequencies studied. The maximum reading was used as the result. The
magnetic component of the field was measured by means of the loop antenna. It was
tuned to the direction of the maximum noise signal by rotating it. Here also a
time period of 3 minutes was employed and the maximum level recorded was used as the
result. The results are given of a measurement of the frequency distribution of the
electromagnetic noise field created by all noise sources in operation in the shop.
Over the entire frequency range studied the electric component of the strength of
the noise field is greater than that of the magnetic component and equals 81 dB or
110 mW/m. The maximum value of the strength of the electromagnetic field lies in
the frequency range of 1.5 to 2.8 MHz, while the ultrasonic internal flaw detection
equipment operates in the frequency range of 0.6 to 10 MHz. Chiefly low-frequency
noise in the 0.14 to 0.5 MHz band with a maximum value of 95 dB or 110 mV, with 0
dB lying at a voltage of 2 μV is propagated through the noise carrying electrical
network. An estimate was made of the signal-to-noise ratio of an internal flaw
detector when operating under production conditions by making a study of noise volt-
age levels in the input and output of the ultrasonic internal flaw detector's am-
plifier. The results of measurements of the noise induced in the cable connecting
an ultrasonic probe with a type UDM-3 internal flaw detector show that the frequency

spectrum of this noise agrees with the operating band of the internal flaw detector and that its level is commensurate with that of useful signals. Other results show that the frequency spectrum of the noise passing through the internal flaw detector's amplifier has pronounced maxima which match the resonance frequencies of the amplifier. The results show that the frequency range of an ultrasonic internal flaw detector and the noise spectrum agree and that their levels are commensurate. It is concluded that it is necessary to develop special noise protection devices and that special filters must be used in the noise-carrying electrical network in order to improve the noise immunity of an ultrasonic internal flaw detector. Figures 6; references: 7 Russian.
[18-8831]

INFLUENCE OF CHARACTERISTICS OF A LENS ARRAY ON DISTRIBUTION OF INTENSITY IN THE ILLUMINATED AREA WITH COHERENT UNIFORM ILLUMINATION WITHIN THE LIMITS OF THE APERTURE

KHVALOVSKIY, V. V., NATAROVSKIY, S. N., NALIVAYKO, V. I., AKIMAKINA, L. V. and MEL'NIKOVA, N. V., Leningrad Institute of Precision Mechanics and Optics; USSR Academy of Sciences Institute of Terrestrial Magnetism, the Ionosphere and Radio Wave Propagation and the Scientific Research Motion Picture Photography Institute

[Abstract] The combined luminous effect of a laser and a lens array is equivalent to that of an extended source of coherent light. As a result, light energy from each lens element of the array arrives at each point on the object illuminated. The characteristics of the lens array, such as the spacing and type of arrangement of elements, the profile of the refracting surface and the aberration characteristics of a lens element of the array, exert an important influence on the nature of the distribution of intensity on the surface of the object. A study is made here of the dependence of the distribution of intensity on these characteristics of lens arrays. An analysis is made of an optical system consisting, in sequence, of a laser, a lens array and a condenser which produce coherent uniform illumination of an object lying in the rear focal plane of the condenser. The distribution of the field of amplitudes, $U(x, y)$, in the plane of the illuminated object is determined by the equation $U(x, y) \backsim F(T_r(x, y)) \cdot F(L(x, y))$, where F is the operator of a Fourier transform, $T_r(x, y)$ is the transmission function of the lens array and $L(x, y)$ is a function characterizing the arrangement of lens elements in the array. Either an orthogonal or hexagonal arrangement of lens elements in the array is employed. Expressions are derived for the diffraction of light in an individual lens element of the array and for the multibeam interference of rays passing through the array. A photograph is shown of the illuminated area when a lens array is employed with a hexagonal arrangement and with a lens element pupil with a hexagonal shape. It is shown that the distribution of the light field in the illuminated area is governed by the transmission function of a lens element of the array. The distribution of the light field will be uniform when there are no aberrations in the lens element. The value of intensity maxima equals $N^2 \cdot M^2 \cdot a^2$, where N and M represent the number of lens elements of the array along the X and Y axes, respectively, and a is the amplitude of the light wave striking the lens array. With a chaotic arrangement of lens elements of the array, however, the intensity is proportional to $N \cdot M \cdot a^2$. The problem is discussed of the fabrication of lens arrays by copying the original on a polymer base, where shrinkage of the polymer results in characteristics different

from those of the original. It is demonstrated that although in polymer lens arrays deformation of the lens's profile takes place because of shrinkage, this nevertheless results in asphericity of the profile and consequently in the better correction of spherical aberration. The paper was recommended by the Department (Kafedra) of the Theory of Optical Devices. Figures 3; references 6: 5 Russian, 1 Western (in translation).

[14-8831]

AN EXPERIMENTAL STUDY OF THE LONGITUDINAL CORRELATION OF LASER RADIATION IN A TURBULENT ATMOSPHERE

KAZARYAN, R. A. and DZHULAKYAN, V. M., Institute of Physical Investigations of the Armenian SSR Academy of Sciences

[Abstract] A He-Ne laser operating at a wavelength of 0.63 micrometers was used in an experimental study performed at the test facility of the Institute of Physical Investigations of the Armenian Academy of Sciences in the fall of 1977. The laser output was collimated with a two meter collimator, included in the OSK-2 equipment set. The portion of a single mode gaussian beam near the axis was cut out with a diaphragm so that an almost uniform distribution of the intensity was obtained at the output. A mechanical shutter was placed in front of the collimator, which passed the beam for about 1 msec. The beam, with a diameter of 15 cm, then covered a horizontal path at about 1 m above the ground. At a distance of $L = 650$ m, the beam was split in half by a semitransparent mirror. The reflected beam fell on a screen and was photographed. The beam passing through was also photographed with an identical scale at a distance of $L + L_1$, where L_1 had values of 2, 50, 100, 150, 200 and 300 m. The wind velocity and direction were measured at the same time, and the structural characteristic of the field of the index of refraction, C_n^2, was estimated. This was accomplished using an uncollimated laser beam which ran parallel to the main beam and which was reflected back from a distance of 200 cm. The transverse component of the wind velocity did not exceed 1 m/sec and the pulse width selected for the laser beam made it possible to consider the turbulent medium as "frozen." The longitudinal correlation length proved to be on the order of 300 m when $C_n^2 = 5 \cdot 10^{-15}$ cm$^{-2/3}$. It is shown graphically that the longitudinal correlation factor for the intensity and for its square fall off by almost a factor of two over the 300 m path. The authors are grateful to A. S. Gurvich for valuable discussions during fulfillment of the work, and D. S. Lebedev and A. N. Ushakov for composing programs and processing on a computer, as well as associates of the Institute of Physical Investigations who assisted in the conduct of measurements. Figures 1; references: 5 Russian.

[5-8225]

ON THE SPECTRUM OF A SIGNAL REFLECTED BY A MOVING EXTENDED BODY

SMIRNOV, Yu. V. and MIKHAYLOV, G. D.

[Abstract] Random oscillations of a body about a fixed center can produce spectral widening of a electromagnetic or acoustic field reflected from the body, where these angular fluctuations can be the result of the random action of the surface or medium on various parts of the moving body. Such a body is represented with a complex shape (e.g., an automobile) in the form of an aggregate of an arbitrary number of elementary reflectors. It is assumed that the receiver and transmitter are colocated at the origin of the coordinate system and that the body moves parallel to the x-axis at a constant velocity along a statistically rough surface; the roughness does not produce any shading effects, while the angles of body oscillation in the vertical plane which correspond to the roughness elevations do not exceed 30°; returns from the surface are disregarded. Assuming that the amplitude characteristics of the reflectors are identical, analytical expressions are derived for the correlation function of the reflected signal averaged over the set of reflectors, as well as for the spectrum of the phase fluctuations and the spectral width of the returns. The derived expressions make it possible to determine the width and form of the energy spectrum of a reflected signal from the known parameters of a moving extensive body and the surface, or solve the inverse problem of determining the surface parameters and body dimensions from the known width and form of the spectrum. The results are applicable to the design of MTI radars. Figures 1; references: 6 Russian.
[314-8225]

OPTIMAL ALGORITHMS AND SECONDARY PROCESSING DEVICES

STRYUKOV, B. A.

[Abstract] One of the most critical problems in the synthesis of optimal radar systems is the determination of the secondary processors which convert the primary parameters (signal parameters) to the target aircraft trajectory parameters in accordance with the criterion of a maximum a posteriori probability, with consideration of the secondary and primary parameters. The design of secondary processing algorithms can be subdivided into the following steps: 1) The determination of the stochastic equation for the secondary parameters; 2) The determination of the equation for the a posteriori probability function based on the stochastic equation; and 3) The analysis of the a posteriori probability function in order to derive a feasible secondary processing algorithm. These problems are solved for the case of a normal distribution of the fluctuations of the signal parameters, which are Markov in nature. The resulting algorithms are applied to the example of a radar for determining the current coordinates of a target being tracked. A block diagram is drawn for the proposed radar and it is shown that the optimal secondary processing algorithms proposed here are quite feasible and can be applied to the development of new types of radar systems, where the functional relationships between the primary and secondary parameters are specified. Figures 1; references: 5 Russian.
[314-8225]

RECORDERS

UDC 534.852+681.337

A 3-CHANNEL HIGH-PRECISION MAGNETIC RECORDER OF INFRALOW-FREQUENCY ANALOG SIGNALS

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 80 pp 88-91 manuscript received 13 Dec 78

GANAPETYAN, M. A., Yerevan State University

[Abstract] A 3-channel device for precise magnetic recording of infralow-frequency analog signals in biomedical research is described. The device uses one track of the conventional Orbita-300 magnetophone (upper frequency limit at 12.5 kHz). The signal spectrum is transformed according to the method of pulse-time modulation with time multiplexing of the channels. The modulators consist each of a controlled driven multivibrator with emitter coupling through a stabilizer of the (differential)amplifier current and with collector-base coupling through an emitter follower and a time setting RC circuit. Playback and input to a computer are effected by means of a time interval-to-code converter and a generator of linearly varying voltage. Precision requires a special-purpose pulse shaper and separation of informative pulses from clocking pulses. Low-noise separation through bilateral limitation with subsequent differentiation and limiting has been achieved by use of a phase inverter and two identical limiters with a Schmitt trigger each. In operation with a Nairi-2 computer the recording error is within 2% without compensation and within 0.5% with compensation of interference caused by tape speed fluctuations. Figures 5; references: 3 Russian.
[21-2415]

UDC 621.317

A DEVICE FOR RECORDING THE SHAPE OF REPETITIVE PULSES

Moscow PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 3, May/Jun 80 pp 101-102 manuscript received 7 Dec 78

MEL'NIKOV, V. I. and ROVNOV, S. F., Gor'kiy Polytechnic Institute

[Abstract] A device for recording the shape of repetitive pulses is described which includes a clamp and a digital variable delay. The sequence of repetitive pulses appears at the input to the clamp circuit and synchronization pulses, each preceding one repetitive pulse, are applied to the input of the delay circuit. The

latter generates trigger pulses lagging a synchronization pulse by a time proportional to its consecutive number. The period of one operating cycle is equal to the time of reading 256 measured points into the recording instrument so that the read-in time can thus be optimized by varying the repetition rate of the synchronization pulses. The accuracy is determined essentially by that of the clamp circuit, its static error being 0.1-0.2%. The device, which also contains two 8-bit counters, a control trigger, a clock generator and a comparator, has been built with series 551 and 552, TK and LR, integrated microcircuits. It can be hooked up to a computer. Figures 1; references: 1 Russian.
[21-2415]

OPTIMIZING THE INPUT CIRCUIT OF THE PLAYBACK CHANNEL OF FM MAGNETIC TAPE RECORDERS

KHARITONOV, M. I. and TARYGIN, Ye. K.

[Abstract]   Since the input circuit of the playback channel of an FM recorder has a marked influence on the signal-to-noise ratio in video tape recorders, this paper optimizes this input circuitry of such VTR's with respect to the signal-to-noise ratio. The optimization which maximizes the signal-to-noise ratio maintains a uniform amplitude-frequency response in the working frequency range. The circuit configuration shows the input circuit driving a video amp which in turn feeds the following components in series: an equalizing network, an FM equalizer, an equalizer with a linearly falling response and a limiter/frequency detector. The example of the determination of the optimum transformation for the coupling of a playback head to the video amp is analyzed for the case where the input stage of the amplifier is designed around the metal-ceramic 6S51N vacuum tube (the KADR-3 VTR). It is found that an optimum transformation ratio exists and proposed technique was employed to optimize the input circuit of the playback channel of the KADR-5 VTR, thereby boosting its signal-to-noise ratio by 2 to 3 dB. Figures 2; references: 4 Russian.
[314-8225]

DETERMINATION OF A TRANSIENT MATRIX FOR A LINEAR DYNAMIC SYSTEM

KOVALEV, Yu. Z.

[Abstract] The transient matrix of the state of a linear dynamic system is represented in the form of rapidly converging matrix series, and it is demonstrated that this representation is helpful in analyzing linear systems by the method of a space of states. It is demonstrated that the expansions of the transient matrix of the state of a linear dynamic system into partial matrix fractions, arrived at from earlier studies, can be generalized on a unified basis making it possible to write a series of new expansions with the improved convergence of a series in terms of partial matrix fractions. The method of constructive auxiliary functions is employed for this purpose. Representations of the transient matrix of state are arrived at, which have the important practical characteristic that the amount of computing work does not depend on the type of factors used in the expansions. It is therefore possible to increase the accuracy of calculations on a digital computer with identical expenditures of machine time and memory capacity, or, with the same accuracy, to reduce expenditures of machine time and memory capacity by using a lower number of terms of rapidly converging series. An illustration of this is given by the example of constructing a transient matrix of state for equations for an asynchronous slave motor. The paper was recommended by the Department (Kafedra) of the Theory of Optical Devices, Omsk Polytechnical Institute. References: 8 Russian.
[14-8831]

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